Eng.
JUL 7 1928

Compressed Air Magazine

Vol. XXXIII, No. VII London New York Paris 35 Cents a Copy

JULY, 1928

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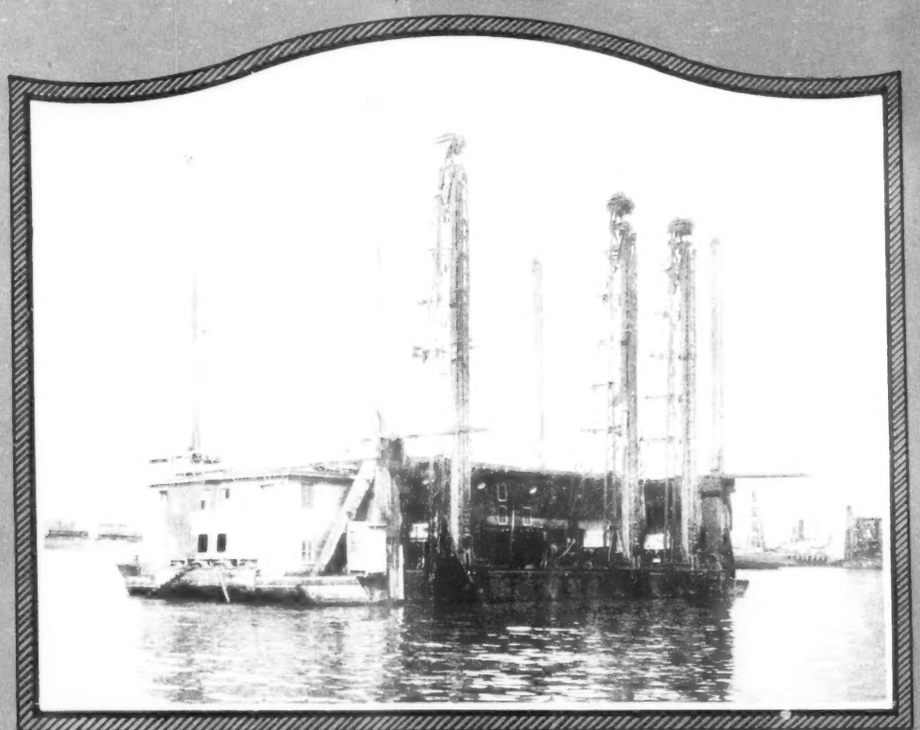

DRILL BOAT "EAST RIVER", EQUIPPED WITH AIR-DRIVEN SUBMARINE ROCK DRILLS, DEEPENING A CHANNEL IN THE PORT OF NEW YORK.

History of the Hecla Mine in Idaho
E. L. Wood

Bottle Plant Saves by Using Oil-Engine Drive
J. S. Meehan

Santa Catalina Island's Varied Charms
R. G. Skerrett

Shongweni Dam Assures Durban Abundance of Water
John Burgess

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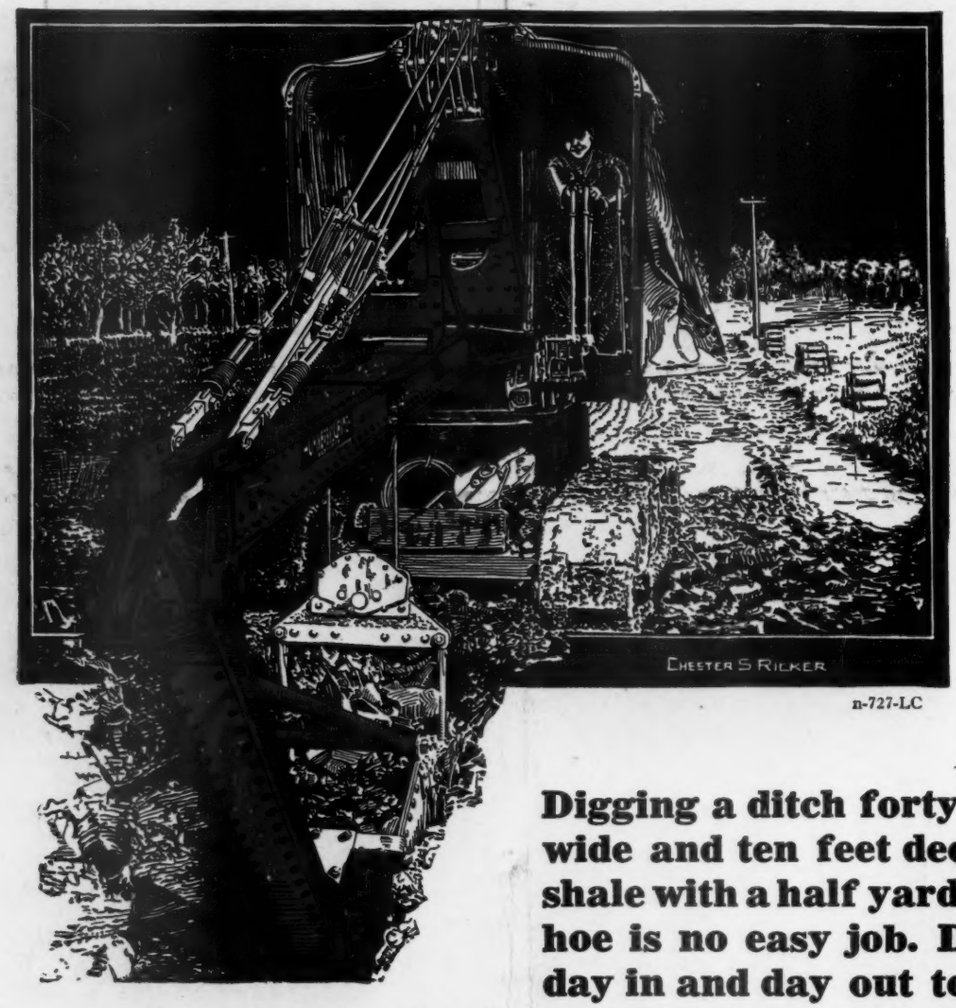
Waukesha-Engined Trench Hoe built by Universal Crane Co.



n-727-LC

Waukesha Powered

Digging a ditch forty inches wide and ten feet deep thru shale with a half yard trench hoe is no easy job. Doing it day in and day out tests the stamina of engine and machine. Power is necessary, of course, but the ability to keep doing it without interruption is more important to the contractor. That's why Universal cranes are Waukesha equipt.

Builders of high-grade machinery, who are most jealous of the reputation of their equipment, are among those who use Waukesha engines. You cannot make a mistake buying machinery that is Waukesha powered. Ask any operator — he will tell you why. Write for "Heads," a booklet that tells why all Waukesha engines are equipt with "Ricardo Heads."

N-850-LC

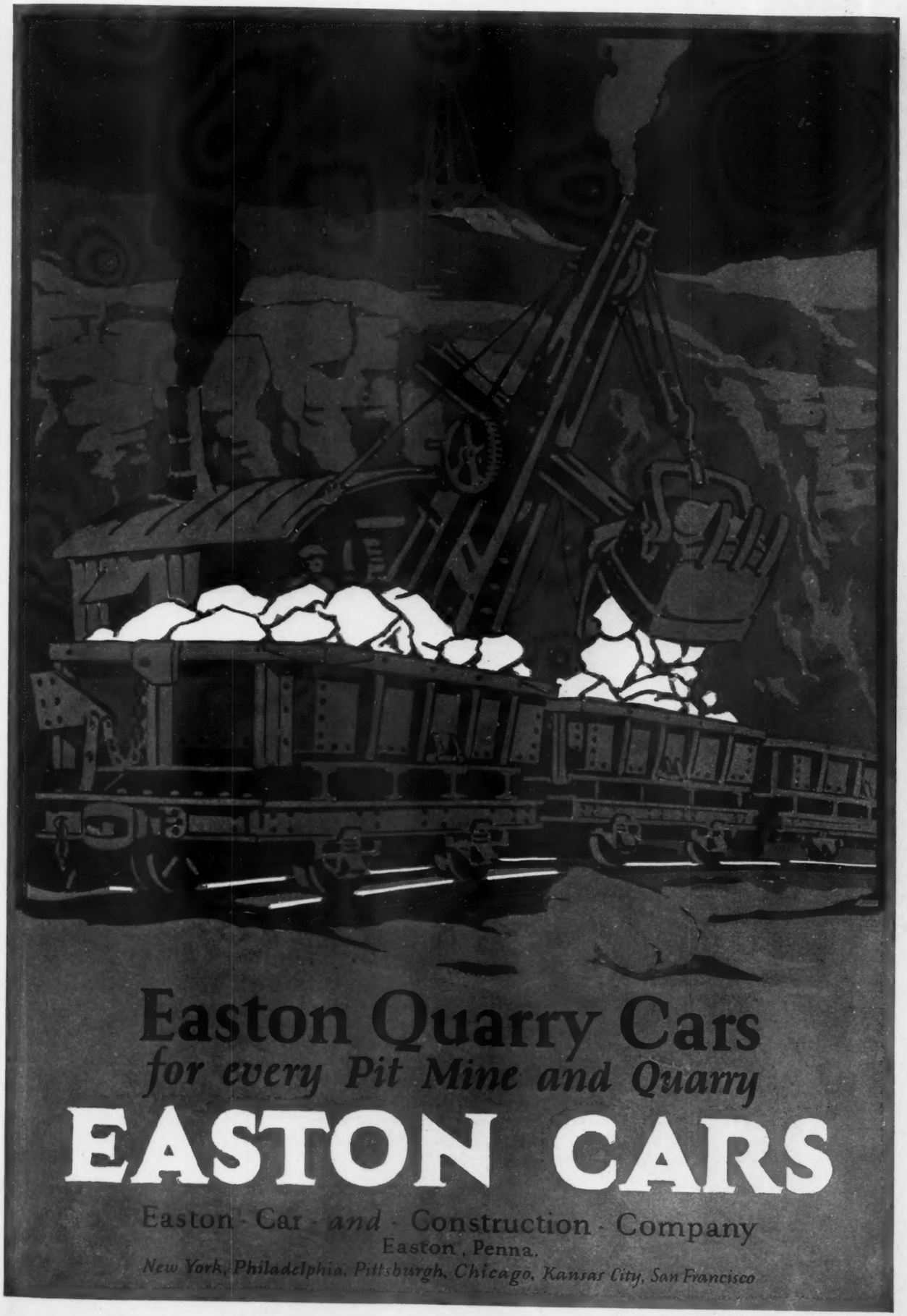
INDUSTRIAL EQUIPMENT DIVISION

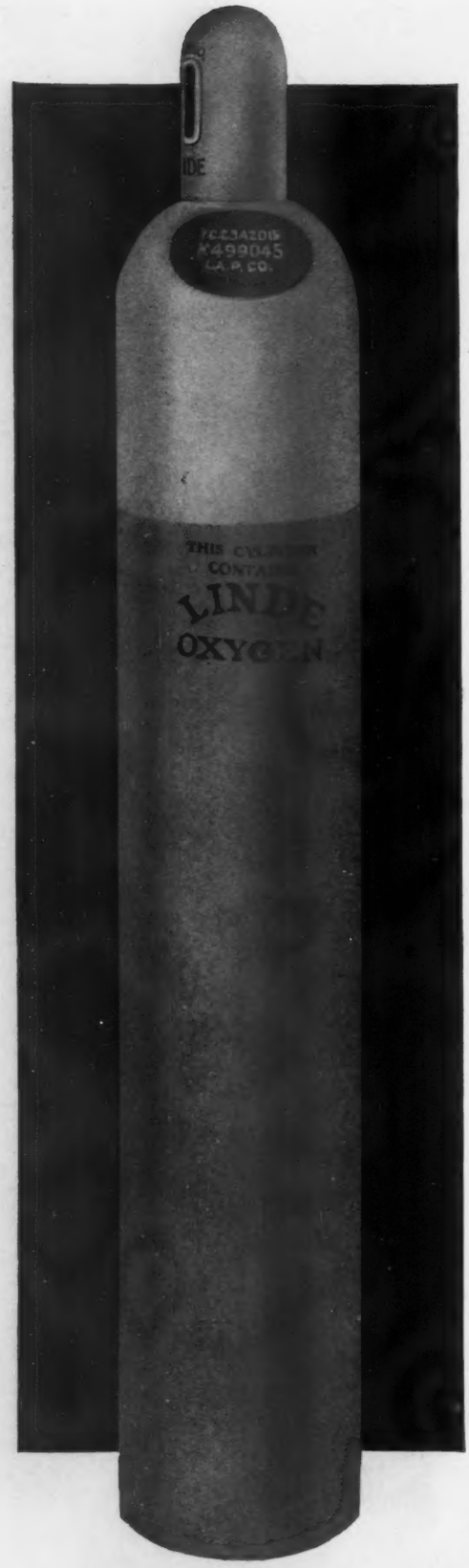
WAUKESHA MOTOR COMPANY

Waukesha Wisconsin

New York	Tulsa	Houston	San Francisco
8 *W. 40th St.*	*C. F. Camp Co.*	*Portable Rig Co.*	*C. A. Watts*

Exclusive Builders of Heavy Duty Gasoline Engines for Over Twenty Years


Easton Quarry Cars
for every Pit Mine and Quarry
EASTON CARS
Easton Car and Construction Company
Easton, Penna.
New York, Philadelphia, Pittsburgh, Chicago, Kansas City, San Francisco



It isn't in the written contract

When you buy Linde Oxygen, you get not only a high grade product, the standard for more than 20 years.

And fast delivery service from the nearest of 48 plants and 105 warehouses.

But also Linde Process Service, always ready to help you get the best results in the most economical way.

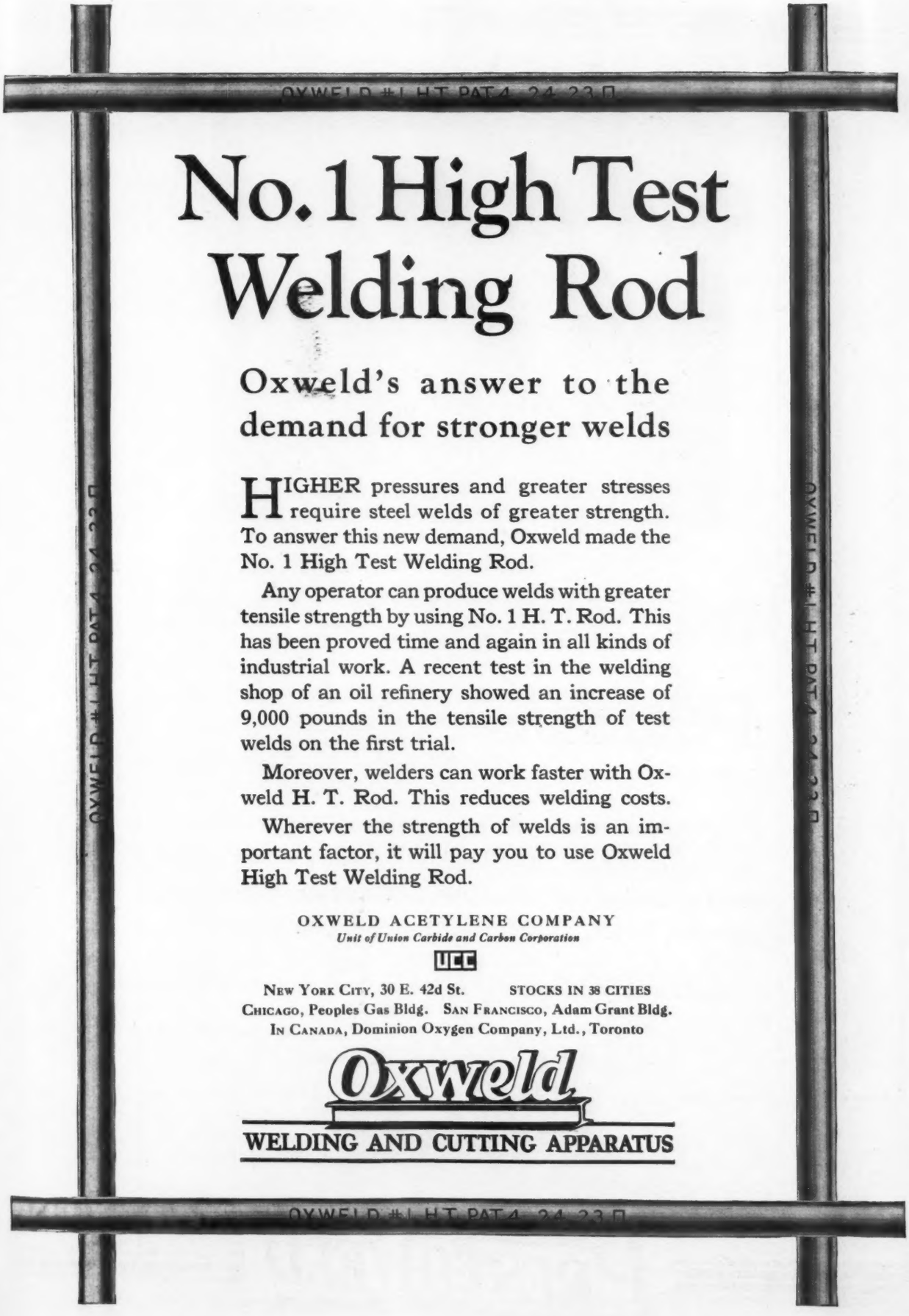
It isn't in the contract, but it goes with every cylinder.

THE LINDE AIR PRODUCTS CO.
Unit of Union Carbide and Carbon Corporation

49 PLANTS UCC 102 WAREHOUSES

General Offices: Carbide and Carbon Building
30 East 42d Street, New York

LINDE OXYGEN



No. 1 High Test Welding Rod

Oxweld's answer to the demand for stronger welds

HIGHER pressures and greater stresses require steel welds of greater strength. To answer this new demand, Oxweld made the No. 1 High Test Welding Rod.

Any operator can produce welds with greater tensile strength by using No. 1 H. T. Rod. This has been proved time and again in all kinds of industrial work. A recent test in the welding shop of an oil refinery showed an increase of 9,000 pounds in the tensile strength of test welds on the first trial.

Moreover, welders can work faster with Oxweld H. T. Rod. This reduces welding costs.

Wherever the strength of welds is an important factor, it will pay you to use Oxweld High Test Welding Rod.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

NEW YORK CITY, 30 E. 42d St. STOCKS IN 38 CITIES
CHICAGO, Peoples Gas Bldg. SAN FRANCISCO, Adam Grant Bldg.
IN CANADA, Dominion Oxygen Company, Ltd., Toronto

Oxweld

WELDING AND CUTTING APPARATUS

Just what you need

PREST-O-WELD blowpipes for oxy-acetylene welding and cutting have a way of paying for themselves almost before you fully realize their usefulness.

Any good mechanic can operate Prest-O-Weld. Sturdy in service, and backed by our own prestige as the leading manufacturers of oxy-acetylene apparatus, Prest-O-Weld is just what you need.

Reasonably priced, and sold by jobbers everywhere.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

CHICAGO
Peoples Gas Bldg.

UCC

SAN FRANCISCO
Adam Grant Bldg.

NEW YORK
30 East 42d Street

PREST-O-WELD

Better Explosives For Less Money

THE new series of Explosives—*Hercomites 2 to 7*—are replacing the old Extra Grades and Extra Gelatins, because they often do better work at less cost.

The table below shows the Extras and Gelatins that the *Hercomites* replace at a saving:

HERCOMITE 2 is nearest grade to	60% Extra L. F. or 40% to 50% Gelatins
HERCOMITE 3 is nearest grade to	50% Extra L. F. or 30% to 35% Gelatins
HERCOMITE 4 is nearest grade to	40% Extra L. F. or 25% to 30% Gelatins
HERCOMITE 5 is nearest grade to	30% Extra L. F.
HERCOMITE 6 is nearest grade to	25% Extra L. F.
HERCOMITE 7 is nearest grade to	20% Extra L. F.

Some of the advantages of the *Hercomites:*

1. Safest type of commercial explosives manufactured.
2. Fumes are better than the Extras and compare favorably with the Gelatins.
3. Number of 1¼" x 8" cartridges runs from approximately 240 for *Hercomite 2* to 350 for *Hercomite 7*.
4. Cost per cartridge is lower.
5. Blasting costs are reduced 10% to 30%, where suitable.

The *Hercomites* represent a distinct forward step in the manufacture of explosives. They are suitable for a wide range of work, and we recommend their consideration to the explosives consuming industries. Descriptive booklet and prices gladly furnished on request.

HERCULES POWDER COMPANY

(INCORPORATED)

Sales Offices: Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.

Hercules Powder Company, Inc.,
982 King Street, Wilmington, Delaware

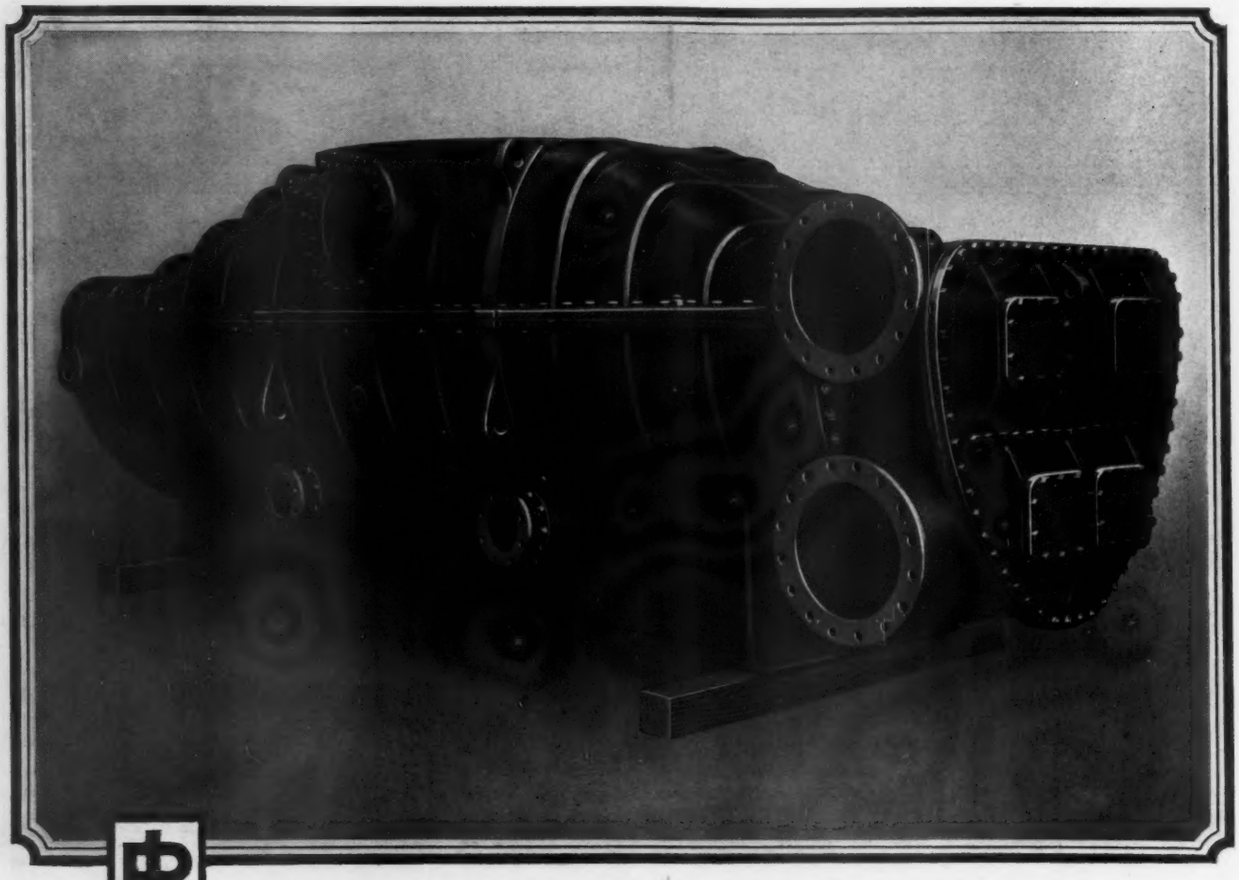
Please send me additional information regarding the new Hercomites, 2 to 7.

Name _____

Company _____

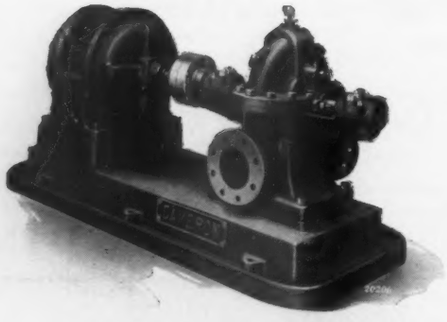
Street _____ City _____ State _____

1523



Ingersoll-Rand Single-Pass Condenser which serves the Turbo-Blower.

At the Donner Steel Company Plant



Cameron L. V. Single-Stage Pump.

The turbo-blower is served by an Ingersoll-Rand Single-Pass Condenser, I-R Steam Jet Vacuum Pumps, and Cameron Condensate Pumps. The condenser water boxes are especially reinforced to withstand the full pressure of the mill water supply, a large part of which passes through the condenser on its way to the mill. These water boxes are divided horizontally to permit the cleaning of half the tubes while the other half remain in operation to carry the load.

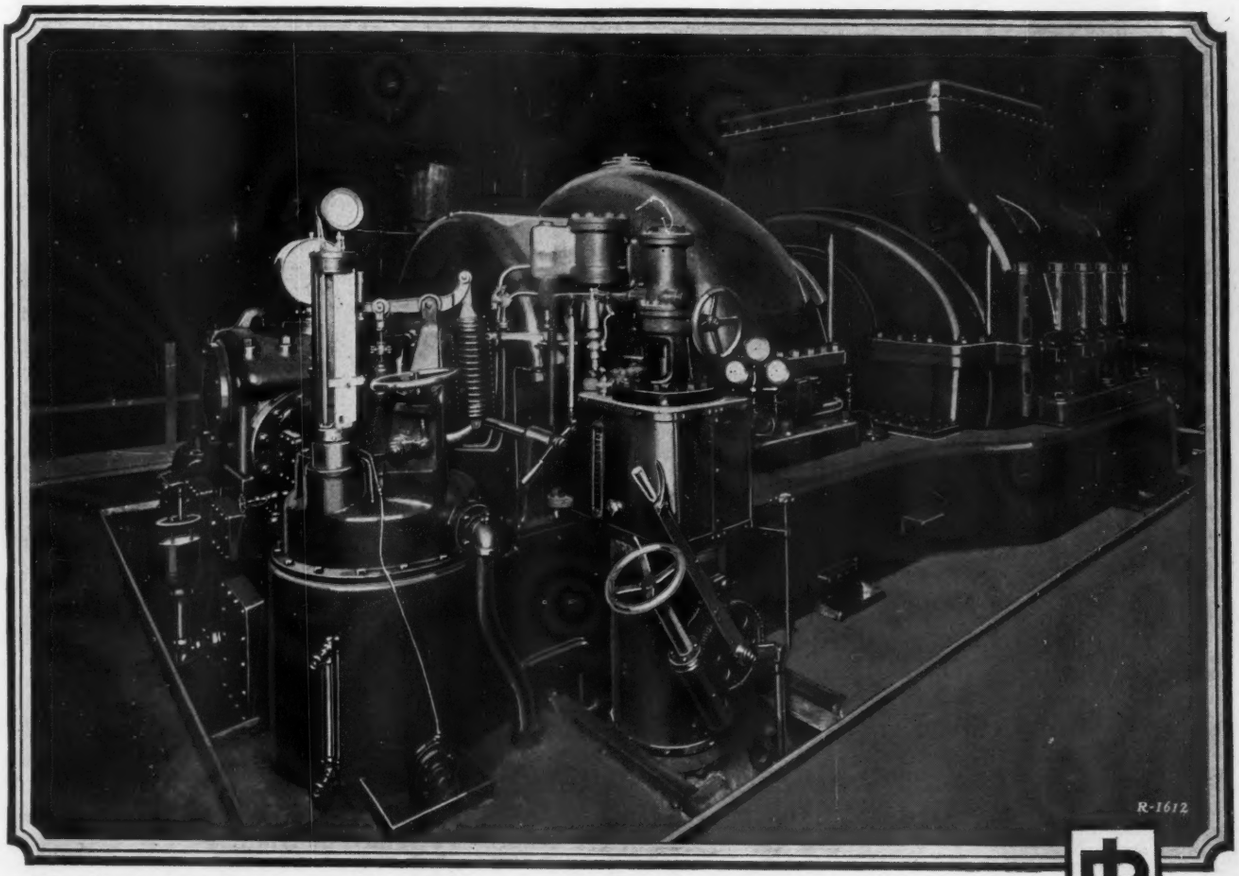
The condenser has the standard Ingersoll-Rand features of longitudinal steam control and external air coolers.

INGERSOLL-RAND COMPANY—11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over.

ATLANTA	CHICAGO	DULUTH	NEWARK	PITTSBURGH	SEATTLE
BIRMINGHAM	CLEVELAND	EL PASO	NEW YORK	POTTSVILLE	ST. LOUIS
BOSTON	DALLAS	HARTFORD	NEW ORLEANS	SAN FRANCISCO	ST. PAUL
BUFFALO	DETROIT	KNOXVILLE	PHILADELPHIA	SALT LAKE CITY	WASHINGTON
BUTTE	DENVER	LOS ANGELES	PICHER	SCRANTON	

For Canada, refer Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec.



This 4-stage I-R Turbo Blower Delivers 60,000 cu. ft. of air per minute at 30 Pounds Blast Pressure.

Another Notable I-R *Installation*

The Donner Steel Company, manufacturer of high-grade alloy and carbon steels, recently installed in its Buffalo plant an I-R Turbo-Blower and an I-R Condenser, complete with auxiliaries for blast furnace service.

The turbo-blower unit consists of a 4-stage blower driven by a 10-stage high-efficiency steam turbine. The turbo-blower has a rating of 60,000 cubic feet of air per minute at 30 pounds blast pressure.

The outstanding features of this unit are: automatic constant volume regulation; volume indicator with barometric and temperature adjustments; wide range of operation without surging or pulsation; rigid and heavy construction; easy accessibility; low steam consumption; and minimum attendance requirements.

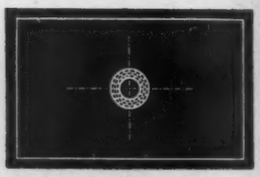
There are 54 similar I-R Turbo-Blowers serving blast furnaces throughout the United States.

53-T

Ingersoll-Rand

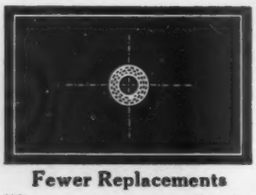
Years of Continuous Service

"The Goodyear 2½-inch style M water hose carrying the residue from our plant to our marsh, has been in service continuously since September, 1924. It has handled approximately 19,000 tons of solid and 78,000 tons of liquid at a temperature of approximately 110 degrees Fahr. Apparently good for considerable further service."—The Krebs Pigment and Chemical Company, Newport, Del.



Good Satisfaction Always

"We have used Goodyear braided air hose exclusively for a period of five years on such various operations as chipping and grinding. We adopted it after making thorough tests of several of the other leading makes of hose. We have also used Goodyear sand blast hose for three years, and it has given us good satisfaction."—Treadwell Engineering Company, Allentown, Pa.

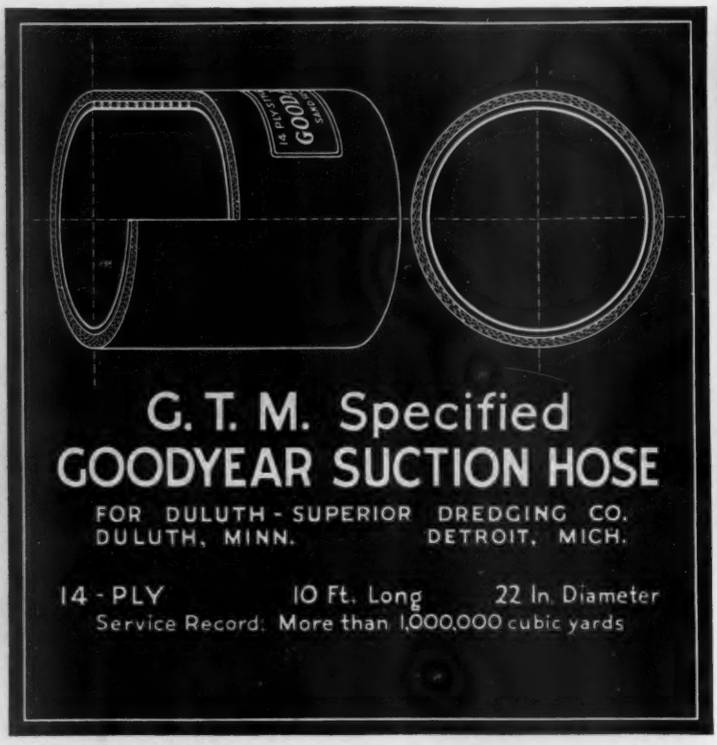


Fewer Replacements

"Our spraying pressure has increased during the past several years from 200 lbs. to as high as 500 lbs. Several makes of hose we know of are improved, but with us the Goodyear Hose is exceptional. We handled approximately 10,000 feet of it last season, and were not asked in a single instance to replace a piece of Goodyear Spray Hose."—Wells & Wade, Wenatchee, Wash.

Extra Months of Hose Life

"The average life of 14 lengths of Goodyear Air Hose in our service is 2 years, 4 months, 20 days. Of six test hoses of another make, the average life was 1 year, 1 month, 3 days. Of still another make, one test hose wore out at 1 year, 9 months, 16 days; of eight out of nine pieces of a fourth make, 1 year, 9 months, 8 days; one piece, spliced to a Goodyear Hose, at 2 years, 8 months."—Superior & Boston Copper Co., Copper Hill, Ariz.


GOODYEAR
G. T. M. Specified
GOODYEAR SUCTION HOSE
FOR DULUTH - SUPERIOR DREDGING CO.
DULUTH, MINN. DETROIT, MICH.
14 - PLY 10 Ft. Long 22 In. Diameter
Service Record: More than 1,000,000 cubic yards

The right hose for your job —and the G. T. M.

Not all hose is made in the same way. Nor should it be. Some must be built to withstand severe abrasion from without, or high pressure from within, or both simultaneously. Other hose must carry steam, or acids, or provide a leakless line for air. Still other hose should have sanitary construction and looks for its first requirements.

To give you the service you require—to give you that service economically, efficiently and over the longest period of time—your hose should be built to your particular needs. The right basis for that kind of hose construction is expert specification to the job.

The Goodyear Analysis Plan is the scientific means by which Goodyear helps users of hose to determine exactly what hose construction will serve them best. The application of this analysis plan is entrusted to the G. T. M.—Goodyear Technical Man.

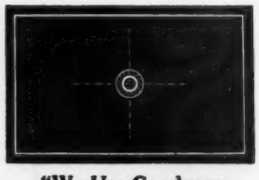
The G. T. M. is an expert on hose. He is familiar with the hose requirements of many industries. In co-operation with your plant officials, he will be glad to analyze your hose problems and help work out a system of conservation to prolong the life of your hose. His successful application of *the right hose for the job* is demonstrated in the testimonials that frame this page, and in hundreds of others like them. If you are interested in getting the right hose for your operations, you can get in touch with the G. T. M. by writing to Goodyear, Akron, Ohio, or Los Angeles, California.

One Length Outwears Two Others

"The white-covered Sanitary Hose which we purchased from you for machine washup purposes has given us the best service of any hose we have used. One length of this hose, which is now in service in our machine room, has outworn two lengths of other hose and is still in service."—Mac Sim Bar Paper Company, Otsego, Mich.

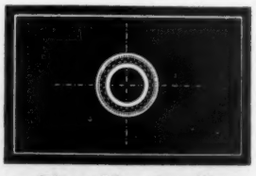
Four Years of Goodyear Service

"We have been using Goodyear Style "M" and Wingfoot Air Hose, together with Goodyear Style "M" Steam and Style "M" Water Hose, for the past four years, and have found them very reliable and the service rendered has been most satisfactory. Furthermore, we have experienced no delay in our work, due to hose failure in that time."—Dick Construction Company, Inc., Hazelton, Pa.



"We Use Goodyear Welding Hose

"We have been using Goodyear welding hose for a considerable length of time, and find it to be suitably adapted for our particular line of railroad car work. We use it both in our shop and on the outside, where it is subject to the elements and hard usage."—Canton Car Company, Canton, Ohio.



Three Years vs. Six Months

"We bought hose for washing sludge out of polishers and saws from every salesman who came along with 'the best hose made.' Most of it lasted a week or so; the best, six months. Your G. T. M. checked over the situation, and recommended Goodyear Sanitary Hose. Still in excellent condition after three years. All our machines are now Goodyear equipped."—Montello Granite Co., Montello, Wis.

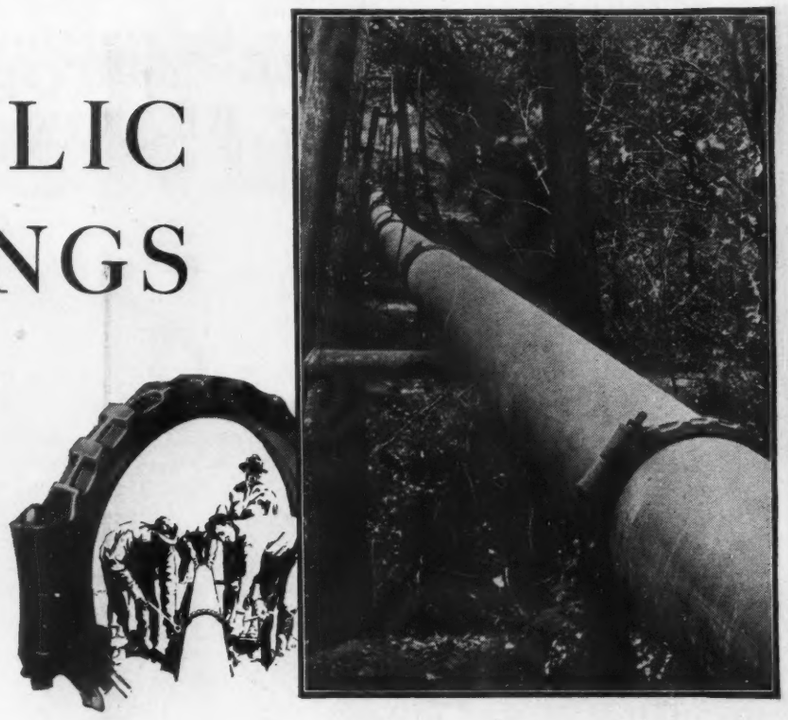
The Greatest Name in Rubber

HOSE · PACKING · VALVES · BELTS

GOODYEAR

Copyright 1928, by The Goodyear Tire & Rubber Co., Inc.

VICTAULIC COUPLINGS



"For every joint on the line"

THIS twelve inch line to Gasoline Plant, near Marshall, Logan County, Oklahoma, was wanted in a hurry. It had to be laid over rough ground. Part of it was buried, but across gullies and swampy ground it was suspended from a steel cable and supported at long intervals by tubular steel frames.

An absolutely leak-proof line with sufficient flexibility to suit these conditions, together with the exceptional economy in time and cost of installation led to the selection of Victaulic Couplings for this 12" vacuum line.

For temporary or permanent pipe lines for crude oil, gas, water, sewage compressed air and a wide range of liquids used in process products manufacture, Victaulic Couplings give permanently leak-proof lines that are installed with large savings in time and money.

Victaulic Couplings are supplied in all sizes for steel, wrought iron and cast iron pipe, for all pressures from vacuum to ten tons pressure per square inch.

"For every joint on the line" *All-purpose couplings*

VICTAULIC COMPANY OF AMERICA

26 Broadway, New York

FLEXIBLE LEAK-PROOF

VICTAULIC

REG U.S. PAT. OFF.

PIPE COUPLINGS

For detailed information and list of uses and users, fill in and mail the coupon.

VICTAULIC COMPANY OF AMERICA
26 Broadway, New York

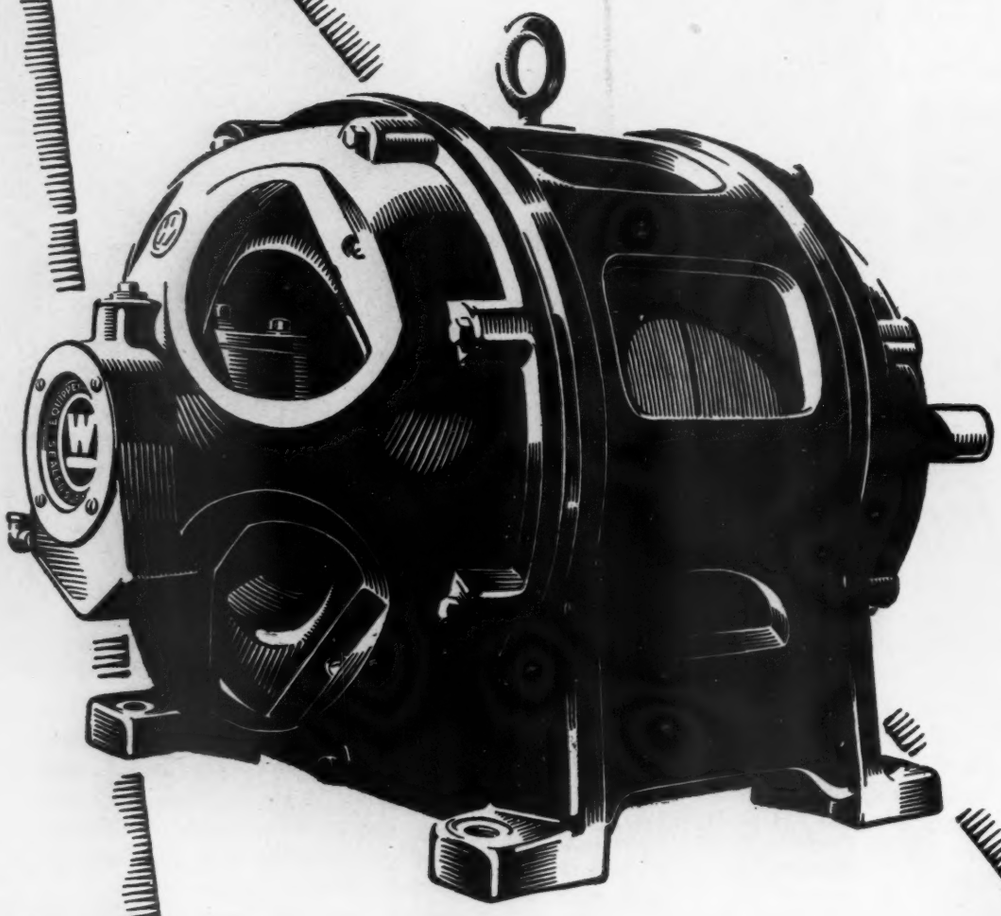
Please send Victaulic Bulletin No. 5 to

Name .....

Address .....

FOR CRUDE OIL · GAS · WATER · SEWAGE · COMPRESSED AIR, ETC.

MORE THAN THE MOTOR RESTS ON THE BEARING



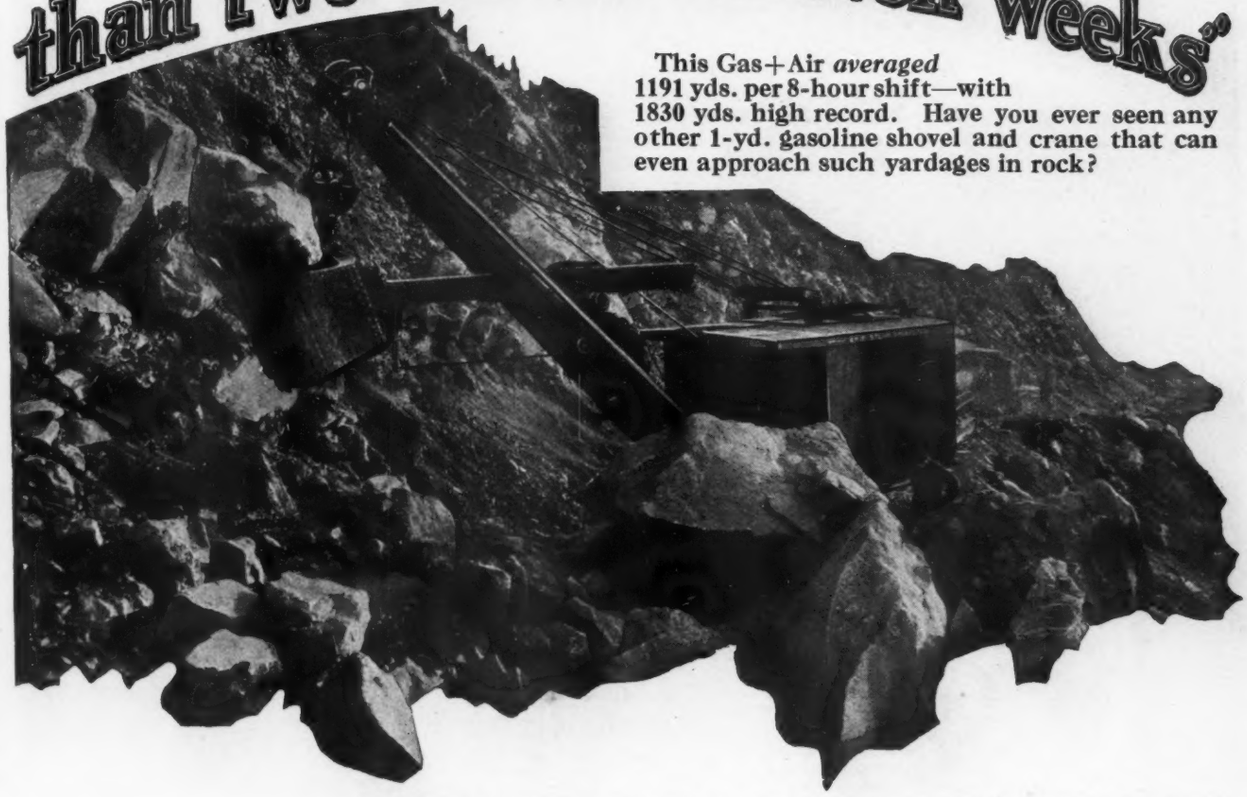
In the chain of modern mass production no single part is independent of the others. Motor performance is more important than ever before; motor bearings are more important. ' ' ' Westinghouse motors have *Sealed-Sleeve bearings.* Oil can't get out; dirt can't get in. The chief cause of motor burnouts—oil soaked windings—is eliminated.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh Works, East Pittsburgh, Pa.
Sales Offices in all Principal Cities of the United States and Foreign Countries

Westinghouse Motors
With Sealed-Sleeve Bearings

X-98178

"Bigger yardage in six weeks than two others in seven weeks"



This Gas+Air *averaged* 1191 yds. per 8-hour shift—with 1830 yds. high record. Have you ever seen any other 1-yd. gasoline shovel and crane that can even approach such yardages in rock?

This well-known Los Angeles contractor reports: "The average for our last 81 shifts, eight hours each, has been 1191 cu. yds.—with a high record of 1830 cu. yds. per shift—digging a heavy boulder formation which required considerable shooting.

"Our expense is extremely low, and we now average only ten men on two shifts in place of 27 men formerly. In six weeks this Gas+Air BUCYRUS-ERIE has moved more material than we previously did with two shovels in seven weeks."—*Lewis Constr. Company, Los Angeles, Calif.*

Then five months later, the Lewis Construction Company

bought another Gas+Air

It's the Gas Shovel for BIG PRODUCTION. The Gas+Air has unequalled speed and Power, because its crowd and swing are driven by direct-connected air engines.

The extra power makes an immense difference in a rock cut like that shown above. And the extra speed means Bigger Profit on every class of work.

This machine has the BUCYRUS-ERIE *Reliability*—present owners of these machines are the best salesmen we have.

Repeat orders for Gas+Air BUCYRUS-ERIES *tell the story.*

A Union of Strength

"BUCYRUS" and "ERIE"—each the most successful manufacturer in its particular field—consolidated Jan. 1, 1928. The unmatched resources of BUCYRUS-ERIE assure the buyer of Unequalled Value, More Efficient Machines, Permanence of the Manufacturer, and a More Complete Field Service.

BUCYRUS-ERIE COMPANY

Plants: South Milwaukee, Wis., Erie, Pa., Evansville, Ind.

General Sales Offices: South Milwaukee, Wis., and Erie, Pa.

Branch Offices:

Boston	Birmingham	Chicago
New York	Pittsburgh	St. Louis
Philadelphia	Buffalo	Dallas
Atlanta	Detroit	San Francisco

Representatives throughout the U. S. A. and Canada.
Offices and agencies in all principal countries throughout the world.

BUCYRUS ERIE

How is this for a Mud-Going Outfit?

The Western 7-yard Crawler Dump Wagon for tractor operation is as far ahead of the team-drawn wagon as that was ahead of the old slat wagon.

A motorized outfit, having all the flexibility of a wagon and nearly double the capacity of a narrow gauge dump car.

Lays its own track, builds its own road, carries its huge load economically through mud, through sand, over rough ground—anywhere and anytime your tractor can go.

Western 7-yard Crawler Dump Wagon

You need this Crawler Dump Wagon. The tractor pulls two—when going is good; and the entire outfit can turn on a 30-foot fill.

You need Crawler Dump Wagons in your business. Bulletin 27-SCM tells the astounding story of their performance. Write today.

Western Wheeled Scraper Company
Aurora, Illinois

WESTERN

DUMP CARS AND GRADING EQUIPMENT

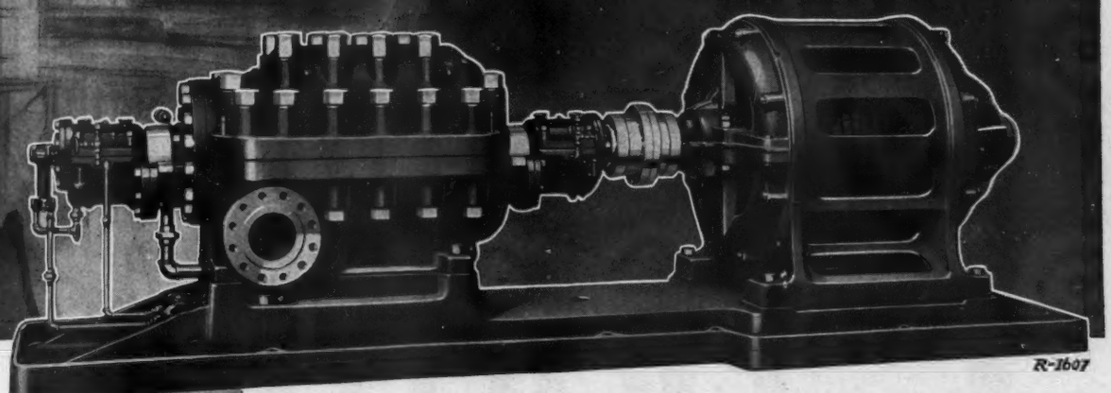
VERSATILITY

Cameron Pumps have not been developed for any one particular field. They are available for all services, particularly where difficult conditions exist, as in:

High pressure boiler feeding
Deep mine pumping
Hydraulic service in steel mills
Long distance oil pipe lines
High temperature oil pumping
Paper mills

This company has pumps suitable for all of these services and its engineers are well qualified to handle any problem presenting unusual difficulties.

A. S. CAMERON STEAM PUMP WORKS
11 BROADWAY, NEW YORK, N. Y.
Canadian Ingersoll-Rand Co., Limited
10 Phillips Square, Montreal, Quebec
Ingersoll-Rand Co., Limited
165 Queen Victoria Street, London, E. C. 4



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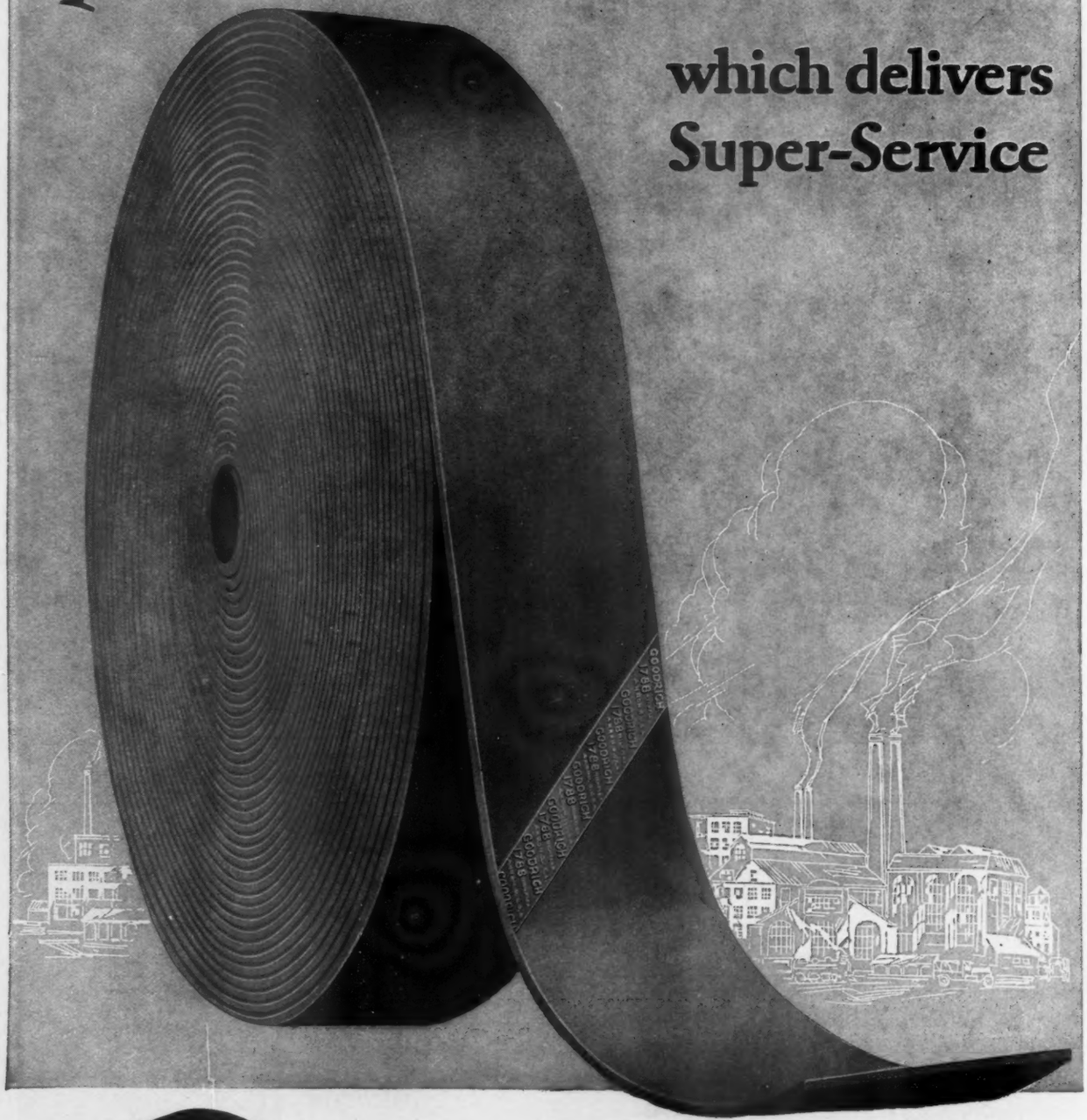
Cameron Pumps

The Transmission Belt

which delivers Super-Service



Goodrich

"1788 Highflex" Belt

THE B. F. GOODRICH RUBBER COMPANY

Established 1870 Akron, Ohio

Supplies 99 9/10 % CLEAN AIR!

The Protectomotor is the simplest and most efficient device of its kind made. Has no moving parts and nothing to get out of order. Made in 5 to 50,000 cu. ft. capacities. Over 250,000 in use.

PROTECTOMOTOR Triples the Life of Air Compressors and Tools!

American industry pays out thousands of dollars every year for losses on pneumatic equipment caused by one common enemy–U-N-F-I-L-T-E-R-E-D A-I-R!

Unfiltered air is a floating mass of millions of abrasive particles that grind and score and wear down the glass-smooth inner surfaces of air compressors, blowers, engines and tools. The result is big losses in efficiency, high maintenance costs and proportionately short life for such equipment.

Tens of thousands of America's large industrial firms have ended this costly "dust tax" by installing the Protectomotor—the filter which is guaranteed to deliver air 99 9/10% CLEAN.

Clean, white filtering element before being placed in service on machine.

After few weeks' service, showing dust, sand, grit and dirt kept out of motor.

The Protectomotor Air Filter reduces carbon deposits 60 to 70%—it reduces wear on moving parts as much as 75 to 85%—and it enables pneumatic equipment to operate three to five times longer than usual before requiring overhauling.

The Protectomotor is also made for pipe line filtration. Delivers dry, clean air for paint spraying, cleaning machinery, pneumatic tools, and all other processes which employ air power lines from a central pressure tank.

PROTECTOMOTOR
REG. U.S. PAT. OFF.
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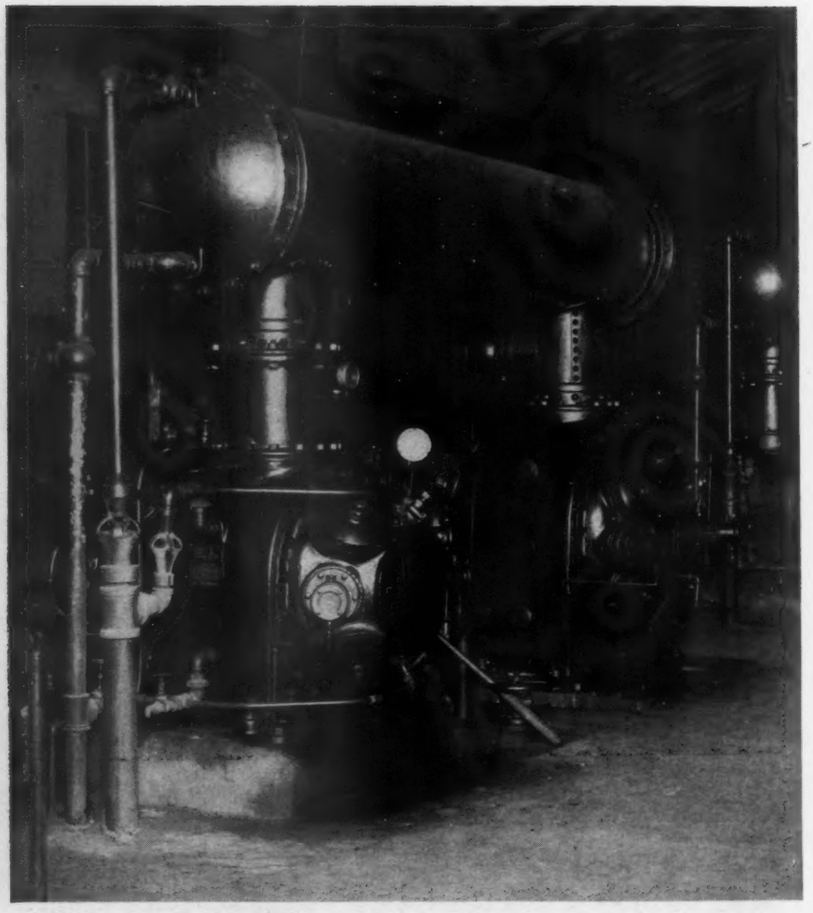

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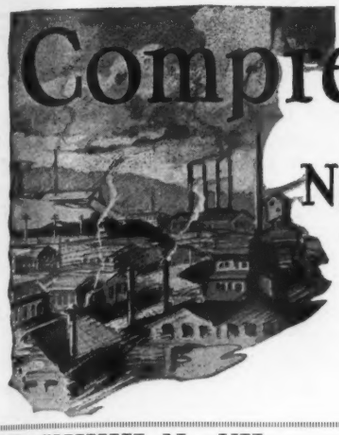

Compressed Air Magazine

NEW YORK · LONDON · PARIS

Principal Offices
Bowling Green Building
No. 11 Broadway
New York.

VOL. XXXIII, No. VII

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Compressed Air Magazine Co.
JULY, 1928

Santa Catalina Island's Varied Charms

Besides Its Picturesqueness and Its Healthful Climate the Island Has a Number of Productive Mines

By R. G. SKERRETT

SANTA CATALINA Island is a colorful place of many charms that draws to it annually thousands of tourists and many others that take pleasure in battling with a wide range of game fish. In addition to this, the picturesque island is a haven for those seeking rest or recuperation.

But even though Santa Catalina Island is most widely known because of its distinctive resort features, still it has industrial activities that have been developed primarily to insure steady employment for those that constitute the island's permanent population.

Foremost in this phase of the island's life are certain mines and a rock quarry that owe their present state to the vision of Mr. William Wrigley, Jr. This article describes, among other things, these mining activities.

SANTA CATALINA Island is one of a succession of islands lying off the coast of California between San Diego, on the south, and Santa Barbara, on the north. Santa Catalina, like the rest of these islands, rises somewhat abruptly from a near-by depth of 2,000 feet and towers above the sea to a maximum height of 2,109 feet— thus indicating a mountainous origin marking either the upheaval of the sea bed or the subsidence of that part of the earth's crust some time in the dim past.

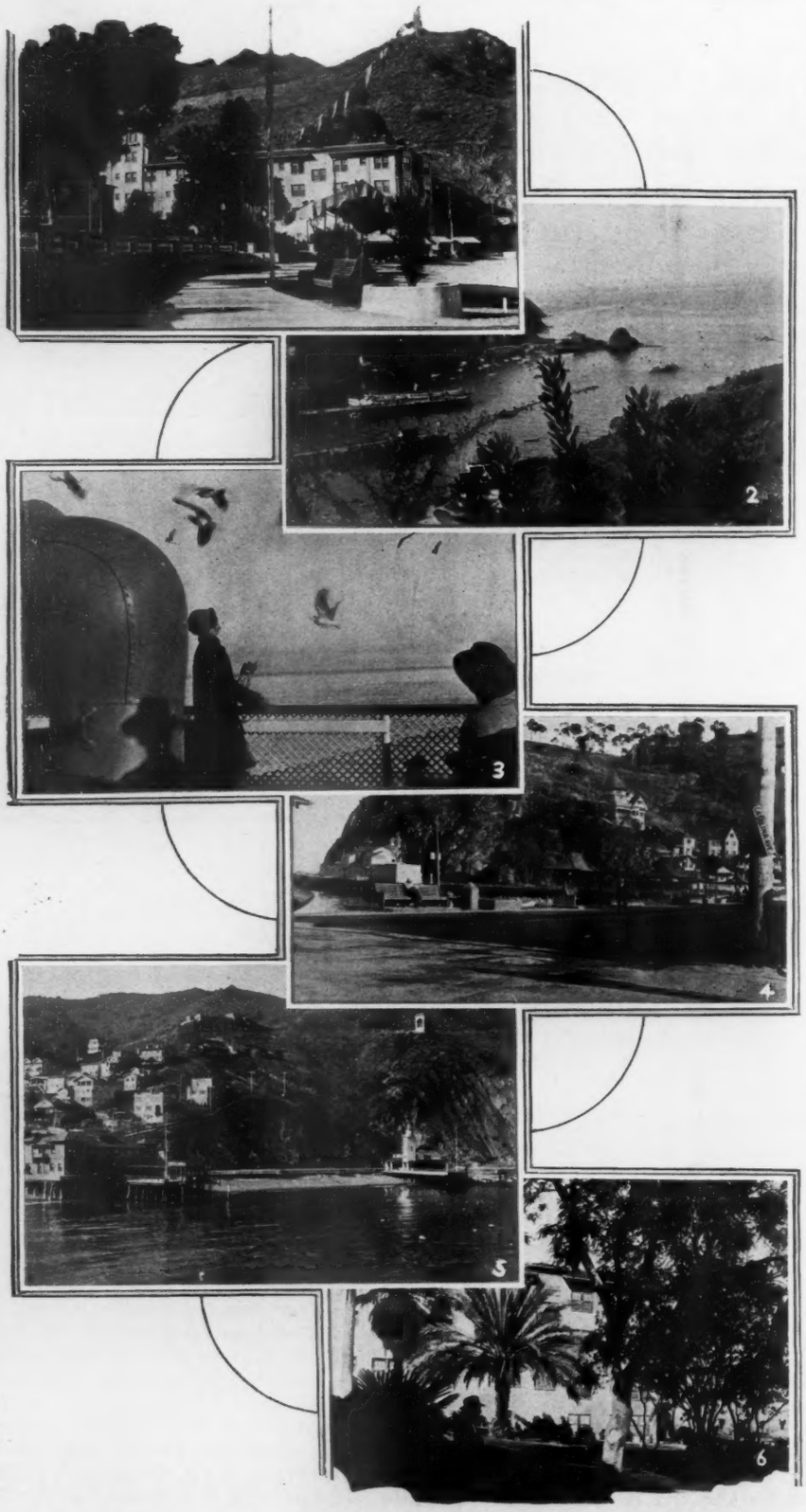
No matter what may have been its genesis, Catalina Island, today, is a beauty spot upon which Nature has seemingly bestowed her best in a lavish spirit. To the island's shores are lured annually many thousands of tourists that are fascinated by its many charms. Furthermore, large numbers of sportsmen, that delight in angling, go there to put their skill to test in exciting battles with game fish that range in weight from a few pounds to several hundred pounds. The deep waters surrounding Santa Catalina teem with swordfish, tuna, albacore, yellowtails, varieties of big sea bass, barracuda, bonito, etc.—fish that can be taken with light tackle and that give the fisherman, the while, a tussle calculated to put him on his mettle.

Those that seek less strenuous forms of recreation can find it in boating, bathing, golfing, and hiking or motoring to the various points upon the island that command picturesque vistas or panoramic sweeps of unusual and extreme loveliness. And for those that wonder how the pellucid waters of the Pacific are inhabited, a trip to the Marine Garden in a glass-bottomed boat will reveal many of the finny denizens of the deep, garbed in rainbow colors, darting hither and thither like animated jewels as they weave their ways in and out through subaqueous vegetation of fantastic forms and hues.

Catalina, as the island is popularly called, lies about twenty miles off the nearest point on the California coast and is reached by a fleet of handsome passenger steamers that make scheduled trips daily between Wilmington—the Port of Los Angeles—and Avalon, a run of two hours'duration. Catalina is 22 miles long and 7½ miles wide where broadest. Its major axis lies in a generally northwestern and southeastern direction; and, physically, Catalina is characterized by mountainous crests, rugged cliffs, shaded canyons, and shining beaches that make the island a bather's paradise. But besides these visible things that hold and please the eye, Catalina grips the imagination because of the mystery surrounding the people or peoples that lingered there for varying periods before the coming of the white man. There is warrant for the belief that Asiatic voyagers landed upon Catalina long before the earliest of European seamen ventured into those unfamiliar waters; and occasional relics have been unearthed that strengthen this assumption.

Lying within the tempering sweep of the Japan Current and also in the path of the refreshing trade winds, and bathed in the sunshine of unclouded skies on an average of 300 days a year, Catalina's climate is both delightful and invigorating. No wonder, then, that this pearl of the California sea coast has been gaining steadily in popularity for years past, and especially so since the island became the property, in 1919, of that enterprising and farseeing spirit, William Wrigley, Jr. Since then, thanks to Mr. Wrigley, a great deal has been done to make Catalina not only more attractive to the transient tourist but also a worth-while abiding place in many ways for residents. In addition to this, Mr. Wrigley has studiously sought to stabilize the living conditions of those forming the year-round population by opening up to many of them opportunities for regular occupation with satisfying rewards. He has achieved this through agencies contributing either to the pleasure and comfort of visitors or to the industrial development of his island dominion—seeing to it that none of these industrial enterprises should impair the unique charms of the island at large or mar the appeal particularly of Avalon, the island's largest port and principal community.

For those that may be unfamiliar with the known history of Santa Catalina Island it might, perhaps, not be out of place here to outline the main recorded facts of its interesting past. As far back as 1542, Capt. Juan



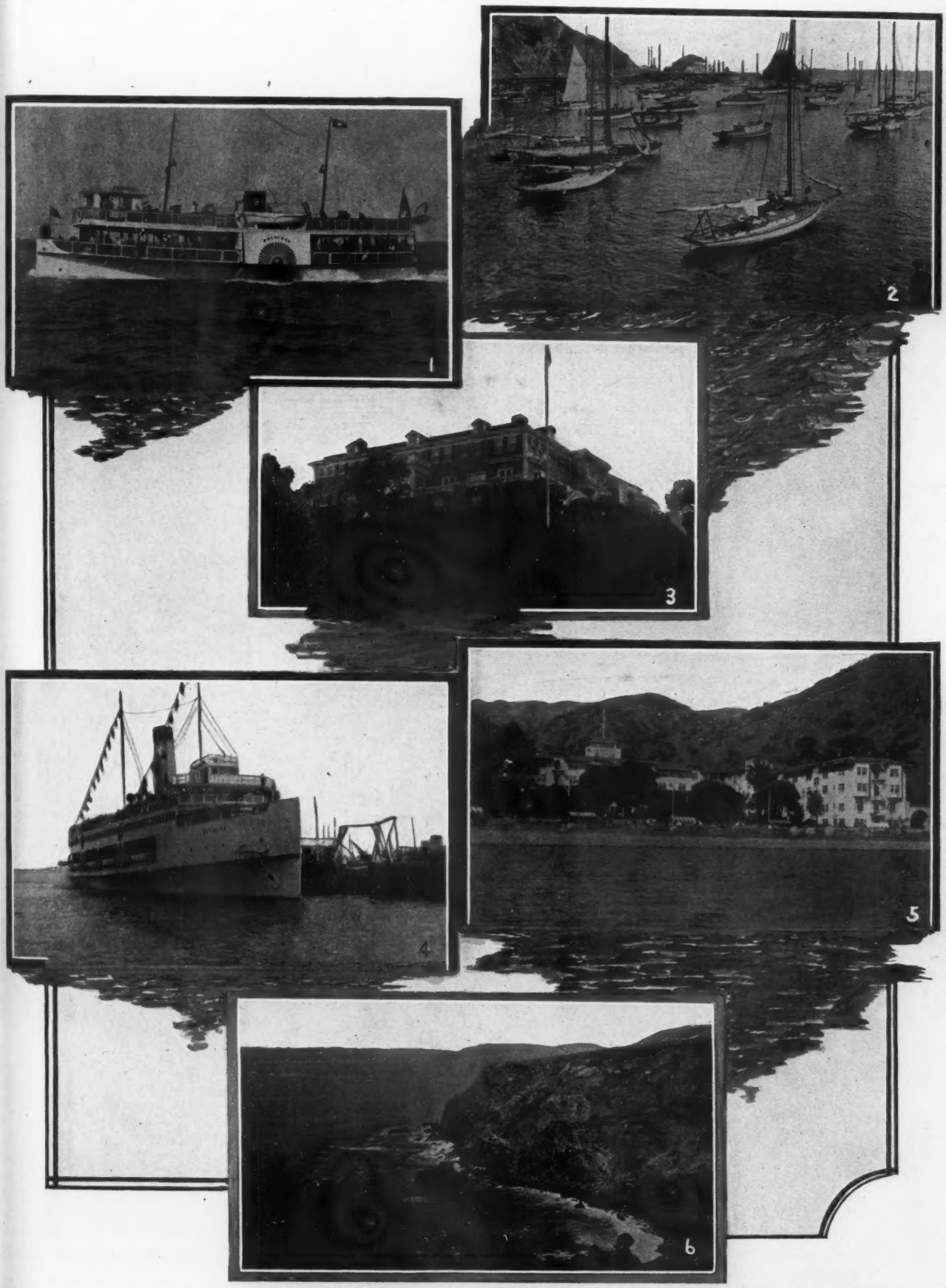
1—Hotel St. Catherine situated by the sea and at the mouth of Descanso Canyon. 2—Vista of Avalon Harbor as seen from the hill to the south of the town. 3—Feeding the sea gulls that follow the ferryships to and from the mainland. 4—The precipitous headland that shelters the Harbor of Avalon on the south. 5—Part of Avalon seen from the harbor. The structure high on the hill at the right houses tuneful chimes. 6—In the cool shadows of the lovely gardens of the Hotel St. Catherine.

Rodriguez Cabrillo—a Portuguese navigator sailing under the flag of Spain—brought his little fleet to anchor within the haven of what is now called Avalon Bay. Recalling the character of craft in which hardy seamen then ventured upon the deep, it is not hard to visualize the courage of Cabrillo or the dangers he encountered in battling with winds and seas in making the long voyage from his home port to the sheltered waters on the windward side of Santa Catalina. He must have found that haven a veritable godsend indeed; and in a spirit of gratitude he named the island La Vittoria after one of the small vessels forming part of his fleet. What happened afterwards for more than five decades is not known; but, in 1602, Sebastian Vizcaino, likewise in the service of Spain, dropped anchor in the same bay off Santa Catalina, and then gave to the island the name with which we are now familiar.

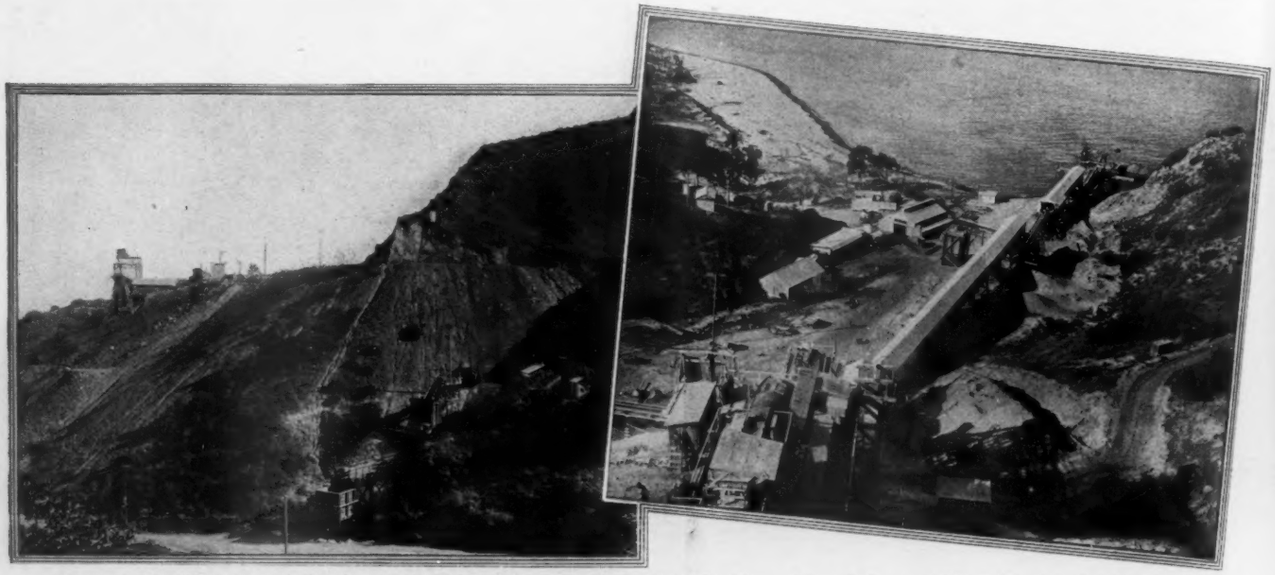
Vizcaino, so history informs us, was directly under the orders of Conde de Monterey, viceroy of Philip III; and his mission was to find a refuge for ships engaged in trade between Manila and the Spanish settlements on the west coast of South America. In this trade, the silks, satins, and fineries of Europe and the spices and other products peculiar to the East Indies were carried from Manila to South America—the boats returning to Manila and, ultimately, to Spain with riches in the form of precious metals garnered mainly from the mines of Peru. Both Cabrillo and Vizcaino were much impressed with the people they found inhabiting the island, whose chief occupation, so they reported, was that of fishing—some of the boats built by them for that purpose being large enough to carry a crew of twenty. Even in those days, and with their rather crude craft, the natives of the island visited the mainland to barter the fruits of their toil for the commodities to be had there.

In the course of time the Island of Santa Catalina became the property of Mexico, and was granted by that government to Governor Pio Pico of California. A while later, it was deeded to one Nicholas Covarrubias, Sr.; and, next, it was bought by James Lick, who, in order to establish his rights had to fight resident squatters. Lick utilized the entire island for the herding of goats and sheep. That may be said to have brought to an end the more or less pastoral life that had been the prevailing one upon Santa Catalina for many generations.

During 1885 Santa Catalina was purchased by G. Shatto. At that time a real-estate boom was at its height there, and the island was subdivided into lots which were offered for sale to the public. The public, however, profited little by the opportunity because an English syndicate, aware of promising silver deposits in certain canyons, promptly bought the island for the purpose of developing its mineral wealth. This venture failed in the end because of difficulties in transportation, but it established the indisputable fact that the island had mineral deposits of much promise. After the English syndicate ceased its operations the island passed into other



1—The steamer "Princess", one of the glass-bottomed boats. 2—The Harbor of Avalon is an ideal haven for pleasure craft. 3—The Wrigley home, on the crest of Mt. Ada, overlooking Avalon from the south. 4—One of the handsome ferryships plying between Catalina and Wilmington, Calif. 5—Hotel St. Catherine, with its fine adjacent beach, seen from the sea. 6—A characteristic bit of the rugged and picturesque coast line of Catalina.



Left—Close-up of the Santa Catalina Island quarry. Right—Near view of the crushing plant and screens.

hands; and, as previously mentioned, the property was acquired, in 1919, by William Wrigley, Jr.

Mr. Wrigley's first concern was to create a model, modern community at Avalon which would make the island still more attractive to the tourist, the health-hunter, and the pleasure-seeker; and the many ways in which Avalon impresses the visitor today are, with but few exceptions, due to his initiative and to the collaboration of his able associate, David M. Renton—popularly known to the habitués of Catalina as "D. M." Mr. Renton is the vice-president and general manager of the Santa Catalina Island Company, which owns and operates this lovely insular domain.

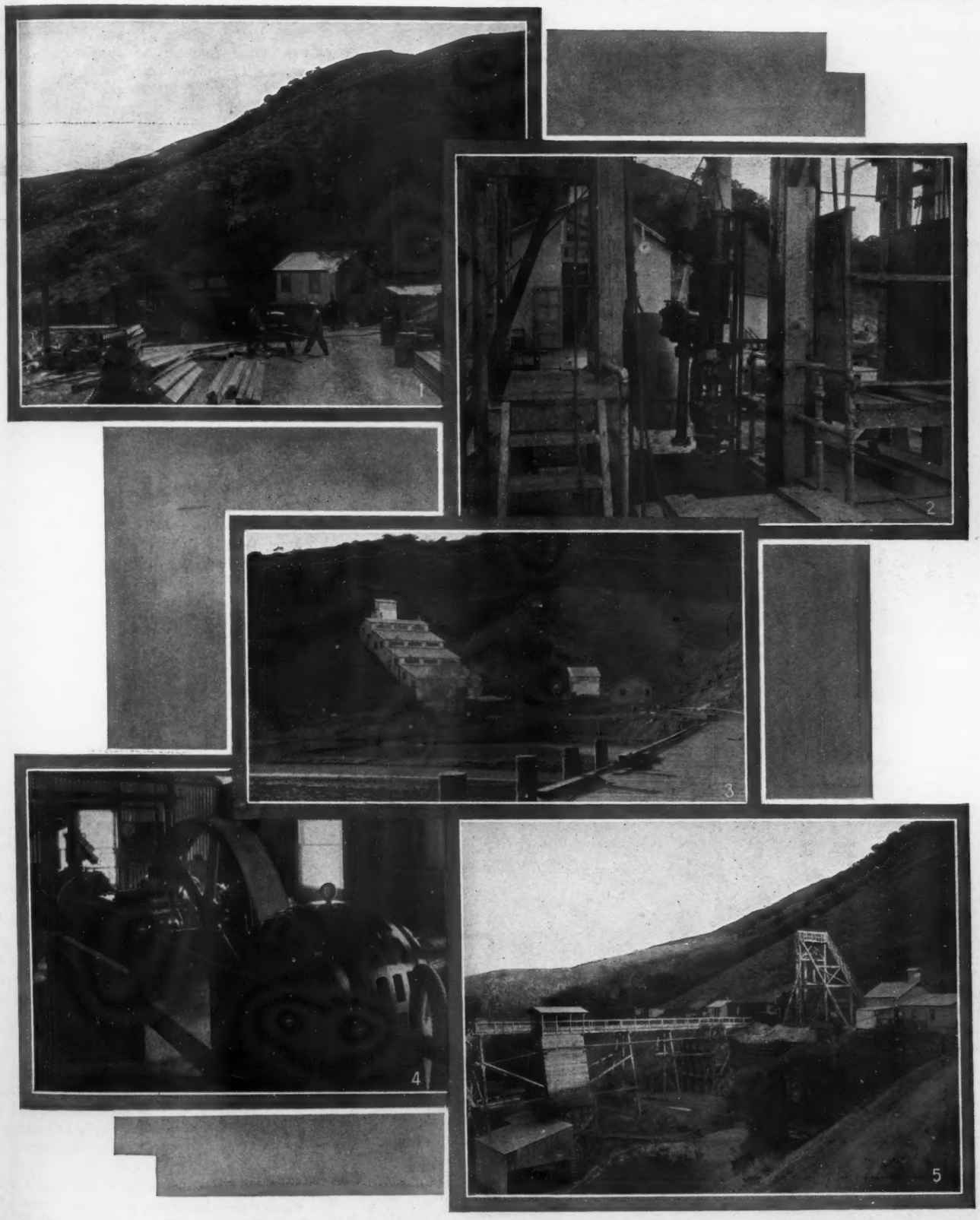
Within the space here available it is unfortunately not possible to tell all that has been done to make Avalon what it now is as a healthful, satisfying, and enjoyable place of residence and a town teeming with a wide variety of more or less exotic charms for the tourist. Many natural difficulties have been overcome in achieving this; and it is safe to say that soon a total of 500,000 persons will visit Catalina annually. And now for a brief survey of those phases of the mining industry on the island that are yearly assuming larger and more significant proportions. Catalina's mineral wealth contributes in no small measure to the prosperity of the island and to the swelling ranks of its permanent population.

Mining is carried on actively at four points on Catalina: at the Rock Quarry and at the Renton Mine, at the south end of the island; at the Black Jack Mine, about eight miles north of Avalon; and at a smaller producer on the west side of Avalon. The Rock Quarry has been for some years the source of crushed stone of a superior sort. This stone has been shipped to the mainland for roadbuilding and has also been extensively used for the same purpose and for construction work on the island. The scenic highways of Catalina run virtually its entire length and make accessible to the motorist and others sections of the island that would, in their absence, be out of reach.

During work at the quarry, within the last few years, air-driven drills exposed a vein of ore containing silver, lead, and zinc in commercial quantities; and in the course of a little more than a twelvemonth substantially 10,000 tons of ore was obtained. This ore has been transported by barges up the east coast to White's Landing, where a mill is established that is equipped with a flotation plant.

The Renton Mine, which is not far from the Rock Quarry, has been a lucrative producer of ore bearing zinc, silver, and lead; and the ore from this mine is also milled at White's Landing. The ore is moved from the Renton Mine to the beach by means of an aerial cableway, 3,700 feet long. The Black Jack is situated in from the coast a distance of about four miles and lies at an elevation of 1,500 feet above the mill at White's Landing. To minimize outlays for roadbuilding and to avoid the high cost involved in trucking, another aerial cableway was constructed having a total length of 9,900 feet. This

Left—Storage yard at the quarry and conveyor for loading crushed rock on barges. Right—As the quarry at the south end of the island appears when seen from the sea.



1—A stage in the early development of the Black Jack Mine, when a portable compressor furnished the needful operating air.
2—A Cameron sinker being lowered into the shaft of the Black Jack. 3—Flotation mill, at White's Landing, which is capable of handling 100 tons of ore daily. The ore is delivered by an aerial cableway extending back to the mine, 3,700 feet away. 4—An XRB-2 compressor which now supplies operating air to the Black Jack Mine.
5—General view of the headframe and associate facilities at the Black Jack Mine.

1—Looking south along Avalon's waterfront highway. 2—A bit of the picturesque gardens of the Hotel St. Catherine. 3—Looking north along Avalon's waterfront highway. 4—The pier at Avalon for the convenience of pleasure boats. 5—On the steamship pier at Avalon. The gentleman in puttles is Mr. D. M. Renton. 6—Sugar Loaf Casino seen from the boardwalk to the south.

cableway—consisting really of two suspended cables—carries detachable buckets, each capable of holding 800 pounds of ore. The descending loaded cable serves to return the unloaded buckets to the mine—a 25-hp. motor being connected with the system to furnish power to take care of the situation when the descending weight is not sufficient to move the cables by gravity.

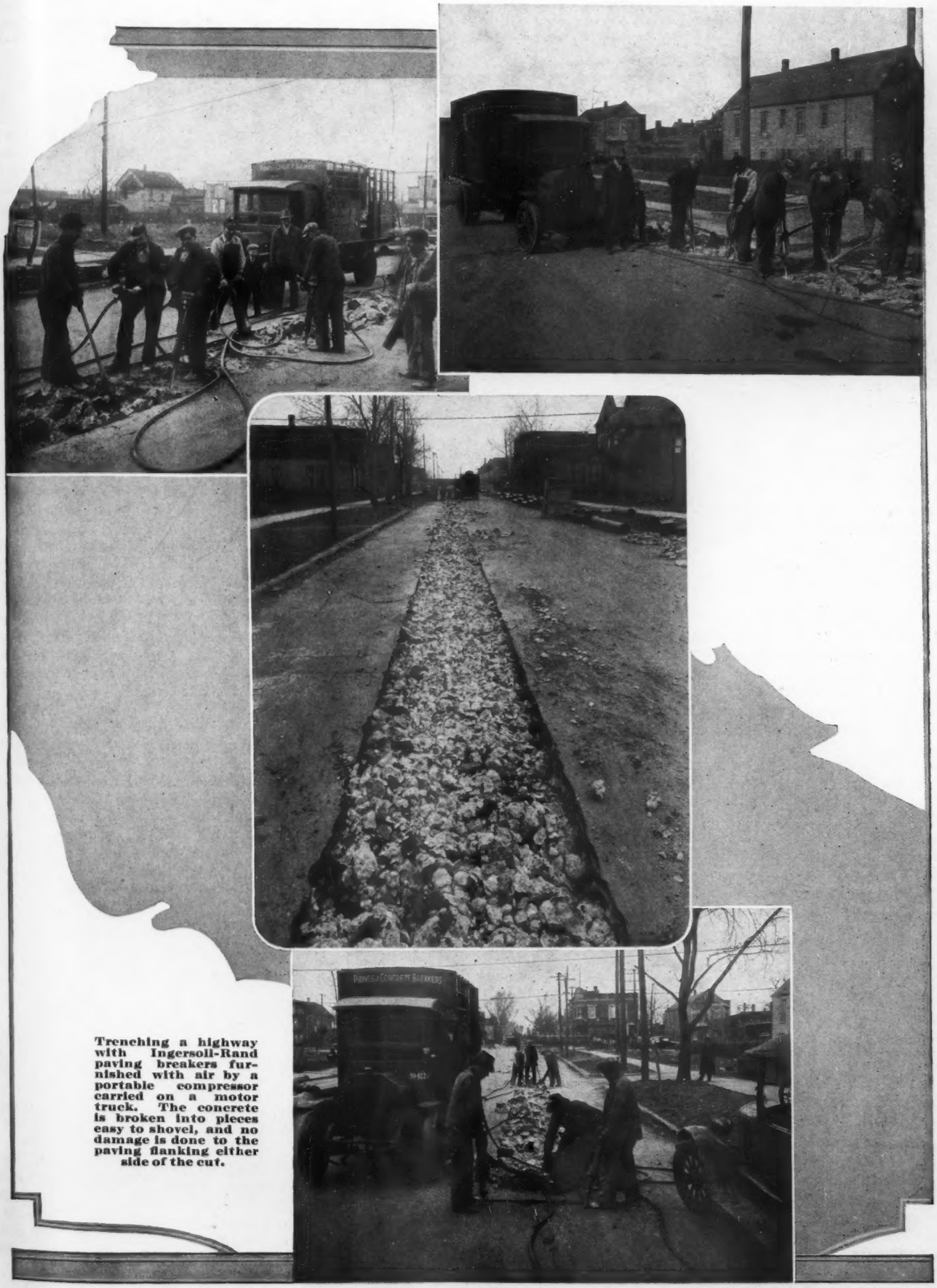
The Black Jack Mine is provided with a 3-compartment shaft that has a depth of more than 500 feet; and work is going on at five levels—each 100 feet apart. The ores taken from the Black Jack are of much the same general character as those found in the other mines on the island, except that some copper has been present in the ore mined at the 500-foot level. In treating the silver-lead-zinc ore by selective flotation, a sea-water circuit is employed—a novelty in operations of this sort. The zinc concentrates are shipped monthly to Belgium by steamer; and the lead-silver concentrates are sent to smelters at Berkeley, Calif.

Air at the Black Jack Mine is supplied by an XRB-2 compressor; and the drilling is done with BBR-230 "Jackhamers" and CC-11 "Stopehamers". An air-operated 1-ton "Little Tugger" hoist has proved a handy equipment for a variety of services. At the Rock Quarry and the associate Quarry Mine much of the heavy drilling has been done with X-70 drifters; and CCW-11 "Stopehamers" have been found effective machines for rock drilling. Here, too, the "Little Tugger" hoist has made good; and a No. 50 "Leyner" sharpener keeps the drill steels in first-class condition. At the Renton Mine the rock is drilled with CCW-11 "Stopehamers" and DCRW-23 "Jackhamers"; and an N-71 drifter has also done excellent work there. Another "Little Tugger" hoist forms part of the outfit of this mine.

All told. more than 50 miles of thoroughly modern roads have been built on the island since it was purchased by Mr. Wrigley; and the policy is to continue this means of opening up the island, as far as practicable, to the motorist so that its picturesque and varied terrain may be enjoyed to the utmost. In this work it is necessary to excavate a great deal of rock—Catalina being fundamentally of a volcanic formation; and in clearing away this rock air-operated drills are indispensable. The motive force for these drills has been furnished by portable compressors.

As can be seen, compressed air is helping both to extract metallic values from local mineral deposits as well as to render the charms of this lovely island more accessible to a continually growing multitude of admirers who are responsive to the unique appeal of this sea-set gem of Nature's making.

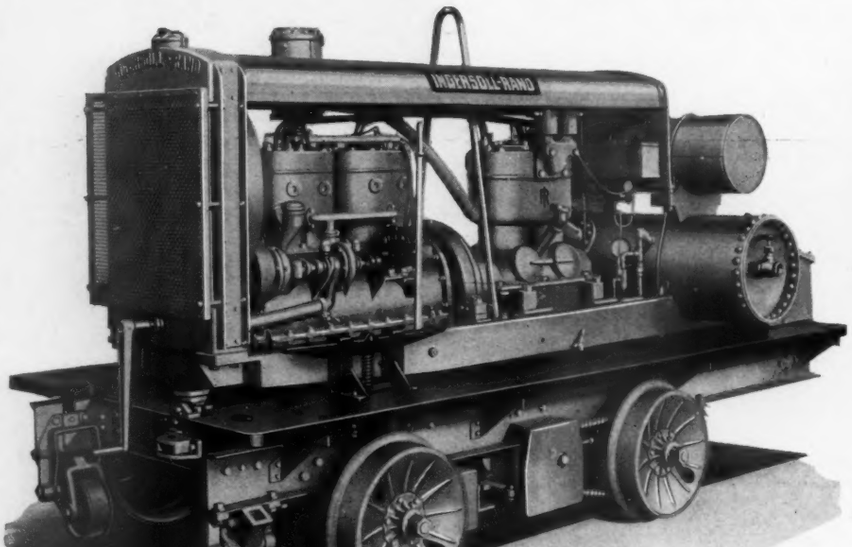
During the first year in which the trans-atlantic telephone was in service between the United States and Europe more than 2,300 connections were made. Since the rates were reduced last March there has been an increase in the number of calls, which now averages 3[illegible] per day, including Sundays and holidays.



Trenching a highway with Ingersoll-Rand paving breakers furnished with air by a portable compressor carried on a motor truck. The concrete is broken into pieces easy to shovel, and no damage is done to the paving flanking either side of the cut.

Notably Improved Portable Compressor For Railway Service

THE backbone of the modern railroad is its roadbed and the surmounting steel rails. The condition of the roadbed and the manner in which the rails are assembled and secured make all the difference between safety, traveling comfort, and economy in train operation. Also, the rapidity with which upkeep and repair work can be done with a given maintenance-of-way force contributes not only to substantial savings but to the observance of established train schedules.



Ingersoll-Rand tie-tamper air compressor, with self-propelling mechanism and swivel-type transverse lifting wheels.

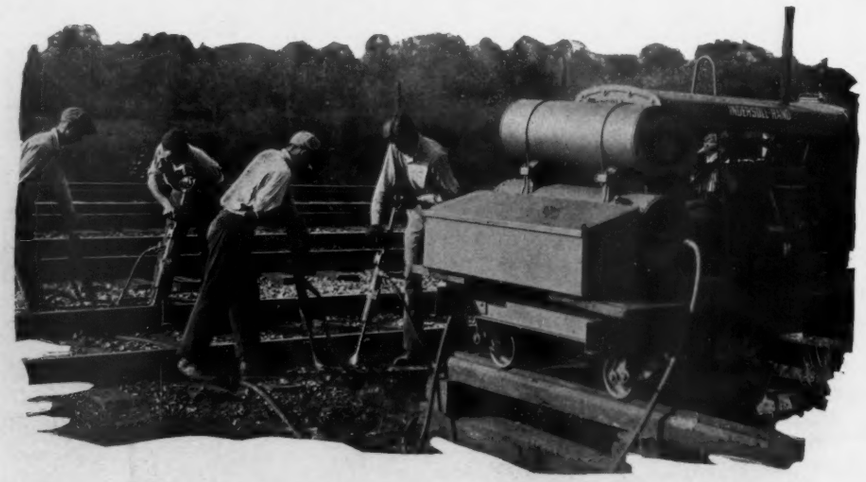
To aid section gangs in this very important department of railroading, numerous labor-lightening tools and allied equipment have been devised—most of them being air-driven so as to call for the least practicable amount of muscular effort on the part of the maintenance-of-way worker. To provide the needful motive air, portable compressors have been especially designed and built for this field of railway service. The Ingersoll-Rand Company has been the pioneer in developing and in introducing labor-aiding compressed-air equipment for use in track construction and maintenance. Still bent upon retaining its leadership in this department of engineering, the company has recently brought out an improved model of its well-known self-propelled tie-tamper compressors.

Heretofore, Ingersoll-Rand self-propelled tie-tamper compressors have depended upon friction drive for their locomotion; but the nature of the service has emphasized the desirability of a still more durable method of drive. The new units are equipped with an independent motor drive—the prime mover being a 4-cylinder air motor that is connected to the axle by a sprocket-and-chain arrangement that possesses the double advantage of durability and positive action. This drive gives a wider range of speed than previously possible with the friction type of drive, and it also permits better control. On descending grades, the air motor functions as an auxiliary brake, so that there is no likelihood of the unit attaining a dangerous velocity when going down a steep slope. Because there are no gears to engage or to strip, the propelling mechanism can be confidently counted upon to give long and reliable service.

The valve operation of the air motor is linked to a long lever that extends above the floor, inside the housing, high enough to enable the operator to reach it when in a standing position. In this way he can have full control of the air motor and, at the same time, be able to reach the foot brake. The foot brake acts upon the idle axle while the air motor is connected with the driving axle, and the net result is virtually equivalent to providing the compressor with 4-wheel brakes. By stepping on the foot brake and by throwing the air motor into neutral a maximum of braking power is obtained. The maintenance-of-way man will readily appreciate what this contributes toward facility of handling and increased safety.

Another improvement consists of swivel-type transverse wheels, designed to make it still easier to move the unit sidewise in running it on or off the tracks. These swivel wheels can serve as lifting jacks; and when so used they obviate the employment of hydraulic, pneumatic, or other kinds of jacks. Another feature of considerable merit is the fitting of the compressor with a drawbar connection at each end for towing purposes.

The desirable 3-point suspension mounting of the entire power unit on the railway car has been retained in the new tie-tamper compressor—a valuable and distinctive feature of Ingersoll-Rand units. This arrangement lightens the work of handling in getting them on and off the track or while blocking them on cribs. All compressors of this kind are provided with lifting bails to facilitate their shifting by locomotive cranes.



Tie-tamping outfit at work. Operating air for the tools is furnished by the compressor placed at side of track.

In a recent issue of *Commerce Reports*, reference is made to a new cable layer, mounted on caterpillars, that digs the trench, lays the cable and fills the trench. The machine has an over-all length of 59 feet, is 10 feet wide, and weighs 22 tons — the excavating equipment alone accounting for 15½ tons. The claim is made that this machine and five men can do the work formerly requiring the services of 150 laborers; and that it reduces the cost of cable laying 75 per cent.

Oil Engine Source of Large Saving in a Bottle-Specialties Plant

In This Case an Oil-Engine Compressor Has Proved Not Only Economical But Conspicuously Efficient

By J. S. MEEHAN

FROM the very nature of the work done in most glass plants there are numerous ways in which operating costs can mount through the careless use of power. Accordingly, every means of saving should be utilized.

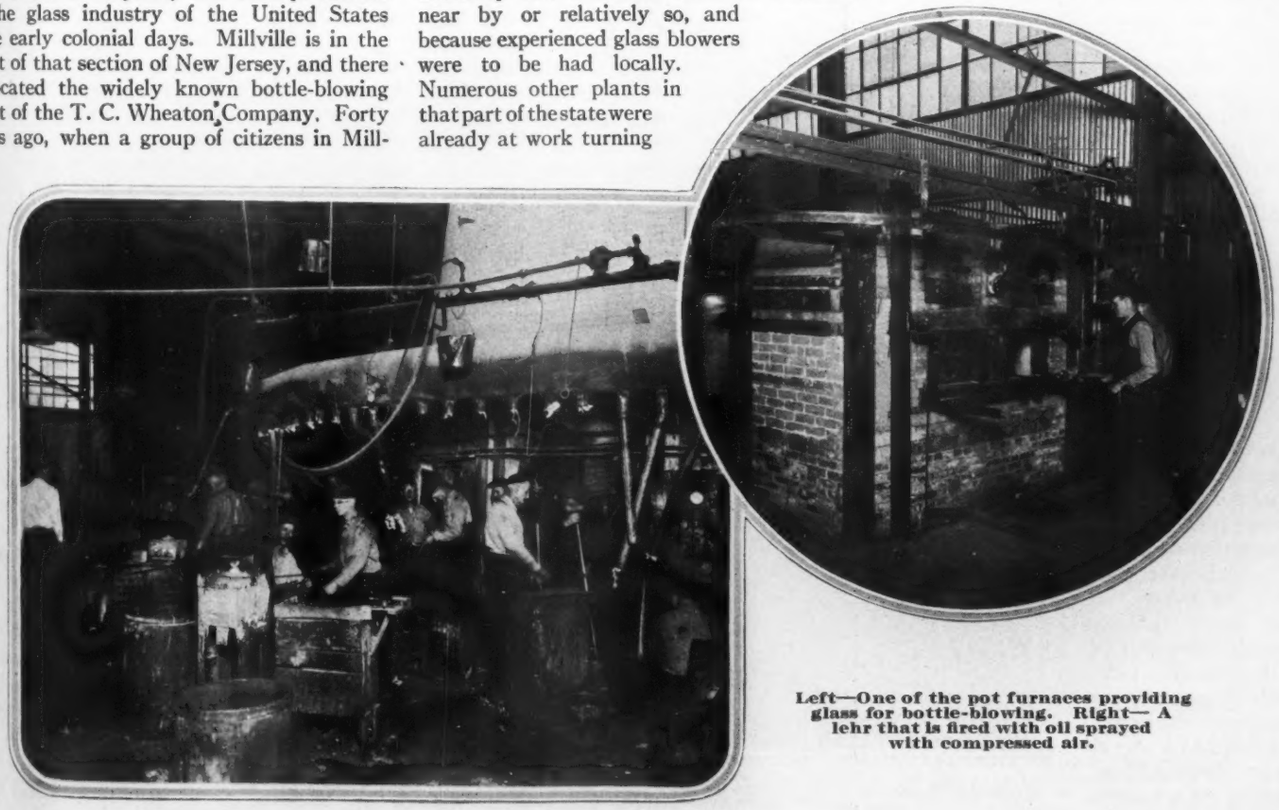
The present article emphasizes what may be gained through the employment of the oil engine as a prime mover in driving a compressor furnishing air for a diversity of services in a glass factory where compressed air is not as extensively used as it often is in glass plants equipped with automatic machinery.

BILLIONS of bottles are blown annually in the United States and are used for a multiplicity of purposes. Indeed, it would be hard for us to visualize how we could get along without these containers. The bottles produced differ from one another in size and in shape, but most of them are made of the same kind of glass—namely, lime glass, because glass of that sort can be readily worked between the time that it is taken molten from the pot or furnace and solidified in the form desired.

The vast majority of these bottles are not characterized by any distinctive finish, but they answer admirably, nevertheless, the requirements of the various markets for which they are made. There are, however, other bottles of superior or artistic finish and form manufactured for special purposes; and certain of these are blown of glass that is different that has been developed to meet the needs of the biological laboratory and other equally exacting departments of the chemical and the pharmaceutical industries. It is with a plant engaged in making bottles of special kinds and of special glass that this article has to do.

Southern New Jersey has been prominent in the glass industry of the United States since early colonial days. Millville is in the heart of that section of New Jersey, and there is located the widely known bottle-blowing plant of the T. C. Wheaton Company. Forty years ago, when a group of citizens in Millville decided that the community was ripe for industrial development, they naturally turned to glass-making because most of the necessary raw materials could be obtained near by or relatively so, and because experienced glass blowers were to be had locally. Numerous other plants in that part of the state were already at work turning out bottles for ordinary purposes on a large scale, and, therefore, the T. C. Wheaton Company wisely elected to specialize and to confine its energies to the blowing of bottles that would fill exceptional or particular needs. The company has held to this policy ever since its inception, and thereby has won for itself an enviable position in the industry. How well it has succeeded may be gathered from its plant expansion. In 1888 the factory had a single pot furnace, and that furnace occupied the center of an otherwise bare tract not more than an acre and a half in extent. Today, the company's plant boasts a number of furnaces, and these, with their associate departments, are spread over an area of twenty acres.

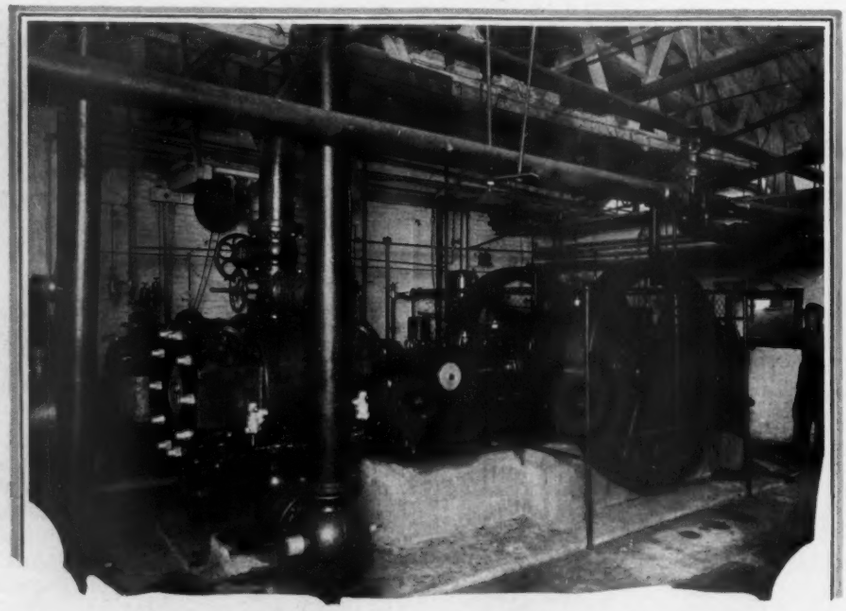
Although typically modern in its equipment, the T. C. Wheaton Company still blows all its bottles by hand. Its personnel is, accordingly, composed either of experts or of men that have attained a very satisfactory standard of operating efficiency. Probably the main reason why the company does its blowing by hand is that its products are extremely varied. Automatic machinery—



Left—One of the pot furnaces providing glass for bottle-blowing. Right— A lehr that is fired with oil sprayed with compressed air.

built mainly for quantity production—would, therefore, not be sufficiently adaptable to meet the widely differing demands. This will be evident once we are reminded that the factory turns out bottles ranging in capacity from half a dram to five gallons—an apothecary's dram being one-eighth of an ounce.

For many classes of bottles made by them, the T. C. Wheaton Company uses a high-grade lime glass. Lime glass consists of a batch of sand, soda, lime, and some cullet—the latter being broken glass that is a by-product or plant waste. The sand or silica is the basic and bulk material; the soda serves as a flux; and the lime acts as a clarifier. The cullet obviates the melting of just so much raw material. The batch is melted either in pot furnaces or in tank furnaces, depending upon the character of the glass and the quantities to be handled.



The oil-engine-compressor unit which now does substantially all the work of furnishing compressed air for the glass plant.

It may be of interest to mention here that while lime glass answers satisfactorily for bottles for many services, still glass of this sort is not suitable for containers designed to hold certain chemicals and therapeutic preparations, because these will sooner or later attack the glass, release the lime, and set up reactions that induce their own impairment or deterioration. The public is generally unaware that glass will dissolve. A bottle of lime glass exposed to rain water or distilled water will show signs of decomposition after only 24 hours! Therefore, in order to protect biochemical preparations and other fluids that must be stored in bottles for some time—especially for export, the T. C. Wheaton Company has produced a special glass that is named "Nosolvit". This is a notable development in the art.

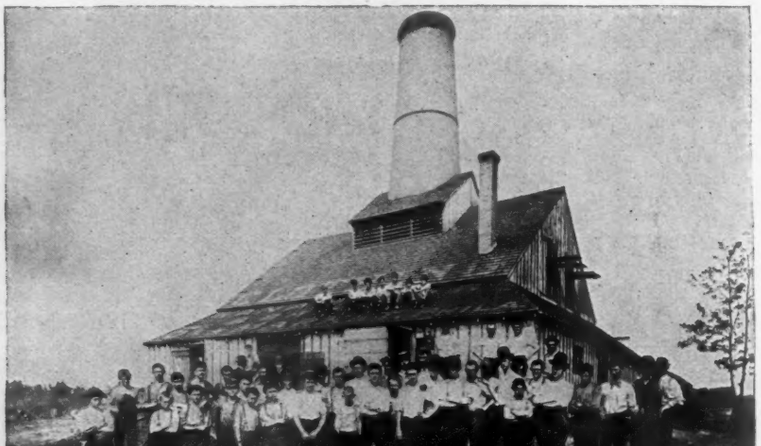
Apart from bottles of conventional form and finish, the T. C. Wheaton Company probably turns out more decorated bottles than any other glass plant in the country. It makes fancy perfume bottles, atomizer bottles, and bottles for toilet specialties—many of them of distinctive model and finished in a way to meet certain proprietary marketing requirements. In addition to these, the company manufactures attractive jars for cold creams and kindred skin preparations; and, finally, it puts out in lesser quantities unusual commodities such as glass knobs of antique design for doors and furniture, lamp stands, etc. Inasmuch as color is the thing of the day, and makes a wide appeal, color is more or less conspicuous in the wares produced at this factory. In some cases the coloring matter is added to the glass while it is in a molten state, and in other instances the coloring matter is applied to the glass after the ware is formed and then made permanent by burning in the furnace. When first applied the coloring is opaque, but burning makes it transparent and vivid. The range of colors is a wide one, and extremely pleasing tones and effects are obtained.

One of the small tank furnaces, fired with oil sprayed with compressed air, in which glass for certain purposes is melted.

The plant is equipped with two pot furnaces and four tanks for the continuous melting of glass. In the pot furnaces—which are circular, domed structures of brick—numerous separate fire-brick pots are used to melt the different batches; and the composition of each batch varies according to the characteristics of the ware to be produced. One of the pot furnaces and all the tank furnaces are fired with oil sprayed with compressed air; and the lehrs or annealing furnaces are also oil-and-air fired—the resulting temperature control being nicer. The many small glory holes, where the forming bottles are reheated before their necks are made, are also oil-and-air fired. The decorating lehr or furnace burns fuel oil sprayed with compressed air; and compressed air is the medium with which the coloring matter is blown upon the ware before burning. Finally, compressed air is utilized to cool the heavy iron molds used in the presses that produce some of the commodities.

Now let us follow the various stages by which any of the small bottles are made. As has been said, this is done by hand—the bottle being given its desired shape by blowing the glass in a 2-part, hinged, iron mold. The workmen are divided into "shops"—a shop in this case consisting of three skilled men who are served by four unskilled men who perform certain helpful operations. One man at the furnace gathers on the end of his blow pipe or iron just enough glass from the pot and passes the pipe to a second man, who works it on a marver or plate—giving the plastic, glowing mass a tapering cylindrical form. After this he lowers the mass into the mold; the mold is closed by the attendant and the blower blows down through his tube and causes the glass to expand and to conform to the shape of the mold cavity. With this operation completed, the partly made bottle is withdrawn as the mold is opened and carried to a convenient glory hole where it is reheated. At the proper time a third man removes the pipe with its attached bottle

1—Cutting and polishing shop. Most of the work is done on grindstones by expert operators. 2—Lehr for the annealing of bottles, jars, etc. 3—Department where glass specialties are ground and given their needful final finish. 4—Stopper-grinding department where every stopper is ground to fit alcohol-tight—emery wheels being used to do this.



Plant of the T. C. Wheaton Company in 1888, the year it began to blow bottles.

and proceeds to give it the needed finishing touch that forms the neck. With that done, the bottle is expertly broken free from the pipe and taken to the annealing furnace where it is exposed for a suitable length of time to diminishing heat to release any internal stresses that might cause the bottle to fracture afterwards when it is subjected to abrupt changes of temperature.

If the bottle is to receive a glass stopper it is sent from the annealing furnace—after inspection—to the cutting and polishing department where mold marks and sharp edges are removed and the ware is polished on sandstone disks. From this part of the plant the bottle is transferred to the stopper-grinding department. There the mouth of each bottle is ground with emery so that the glass stopper will fit alcohol-tight. Every bottle, with its associate glass stopper, represents a separate job that must be done with exactness. If the bottle is to be colored superficially it next goes to the decorating department where the desired color, made fluid, is sprayed on with compressed air. If the decoration is limited to a proprietary symbol, design, or name, this is stamped on; and in either case the bottle is carried thence to the furnace for burning.

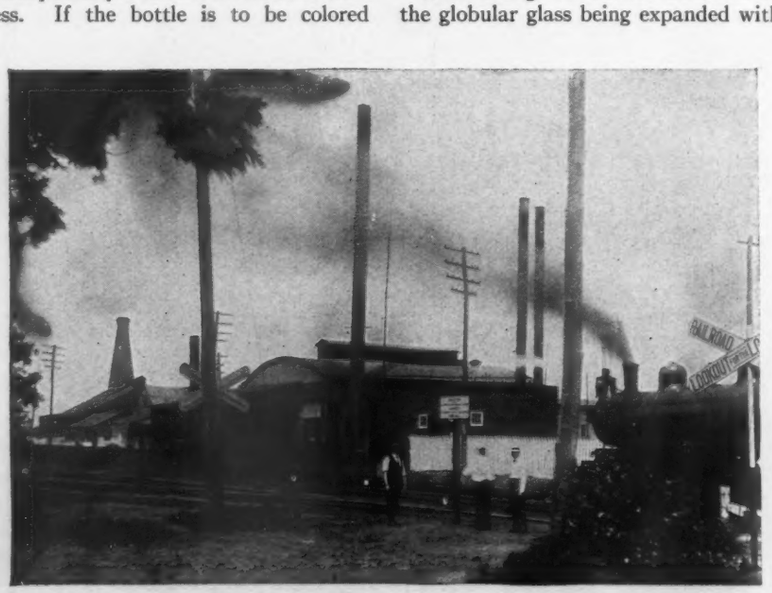
Frosting is done by dipping the ware into hydrofluoric acid. If the bottle is to be given a crackle finish—which is especially effective when the container is to hold a colored fluid, the crackle is produced by heating the bottle suitably and then dipping it into water. To do this successfully calls for a nice regulation of temperature and for a measurable amount of skill on the part of the operator, because otherwise the crackle might be too deep and seriously impair the structural strength of the container, if it did not induce complete fracturing.

Even though all bottles are hand blown—the globular glass being expanded within the mold by the forceful breath of the blower, still enough has been said to make it evident that much compressed air is used throughout the factory for different purposes. Prior to the spring of 1925, compressed air was furnished by four small compressors—two of them steam driven and two of them electrically driven. These units are now retained only as reserves; and since April 3, 1925, they have, with the exception of a few brief periods of service, remained for the most part inactive. On that date there was put in operation an oil-engine-driven compressor of the POC-1 type—the engine being rated at 100 b.hp. when making 240 revolutions per minute. The engine has a cylinder bore of 17 inches and a stroke of 19 inches, and is direct connected to a single-stage, double-acting air compressor which has a bore of 16 inches and a stroke of 19 inches. The piston displacement is 1,122 cubic feet of air per minute. With a discharge at 30 pounds per square inch, the machine compresses 922 cubic feet of air per minute. A pressure of 25 pounds is maintained on the main air line running through the plant.

The purpose in putting in the oil-engine compressor was to effect operating economies and the company has ample warrant for satisfaction in its course in this matter. Like in most glass plants, work is carried on continuously; and compressed air has to be available in the Millville factory 168 hours a week. By having recourse to a single form of drive—to the highly efficient and notably economical oil engine—the management has been able to obviate dependence upon two differing and higher-priced sources of motive power. The power-plant engineer is by training a steam engineer; and the oil engine, when first installed, was entirely new to him. It would be difficult now to find a more earnest, yes enthusiastic advocate of the oil engine and he points with outspoken pride to his performance record and calls particular attention to the fact that he has run the POC-1 unit throughout a single stretch of eight months and ten days without even a momentary stop. The next longest non-stop run was for six months.

It is reported that at the end of the long run, just mentioned, there was so little carbon in the head or combustion chamber of the engine that the entire accumulation could be held in the palm of one hand. Because the oil-engine compressor has shown very substantial savings from the beginning, it has been relied upon nearly without cease for all the compressed air used in the plant. The following operating cost, should, according, be of interest to other plant managers. During the twelve months between July 1926 and July 1927, the POC-1 unit ran 8,650 hours out of a possible 8,736 hours. In that period the engine consumed 21,115 gallons of fuel oil at 5¾ cents a gallon. The fuel cost for that year was, therefore, $1,214.11—representing an hourly cost of 14 cents and an average hourly consumption of 2.0441 gallons.

Accurate data concerning the amount of lubricating oil used by the POC-1 is not available inasmuch as the dirty oil from the engine



The T. C. Wheaton plant as it is today, covering an area of twenty acres.

is utilized elsewhere in the plant. Furthermore, the dirty oil is not reclaimed for re-use by centrifuging. The practice is to take the used lubricating oil periodically from an accessible sump storage tank and then to distribute it to different machines throughout the factory. This oil has been quite satisfactory as a lubricant for those machines. It is not objectionably gritty because so much oil is needed in the plant that it is withdrawn from the sump at relatively frequent intervals; and, besides, an ordinary bag-type filter, connected to the force-feed lubricating-oil system, has proved an effective means of removing foreign matter. Were the compressor lubricating oil not utilized in this manner, then figures would probably be available showing the actual consumption of this oil for the POC-1 unit alone.

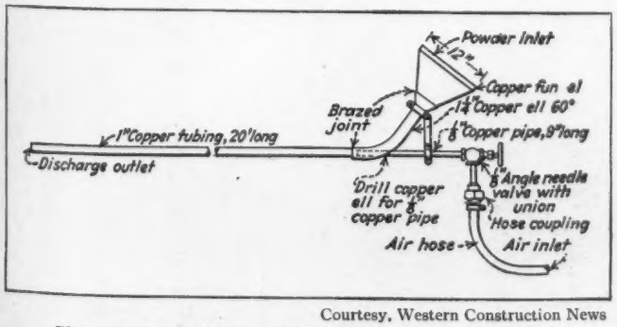
It is reported that the annual outlay for repairs, including the mechanic's time, averages $93.81. Cooling water is paid for on the basis of a low yearly charge for a connection to a 2-inch supply tap. No charge is made for the water by the gallon. An interesting phase of the water question is that in connection with the water used in washing fancy glassware. Formerly the T. C. Wheaton Company paid $18 a week for heating this water: now it is able to utilize for this purpose the water that has gone through the circulating system of the oil engine. In this way a saving is effected that covers more than half the fuel cost given in a preceding paragraph.

As economy is the operating keynote in all efficiently managed plants, the experience of the T. C. Wheaton Company should prove of value to other concerns also seeking to make savings wherever possible without reducing profitable output.

LOADING HORIZONTAL DRILL HOLES PNEUMATICALLY

THE difficulty often experienced in loading horizontal drill holes with black powder has been overcome, so it is said, by an ingenious apparatus devised by M. L. Sullivan, superintendent of construction, of the California Highway Commission, in charge of the removal of blind curves on the Ridge Route. In this contrivance, the powder from the original container is poured into a funnel, as shown in the accompanying drawing, and is then forced through a 1-inch copper tube to the bottom of the hole.

The work of loading is done with compressed air, which is generally available on jobs where rock blasting and the like is done; and a ⅛-inch bronze needle valve, at the outer end of the tube, serves to release the air supplied by a portable compressor. As the hole is filled with powder, the tube is gradually withdrawn. It is claimed that as much as 25 pounds of black powder has been placed with this equipment in approximately 30 seconds.



Courtesy, Western Construction News

Sketch of the air-operated powder-loading device.

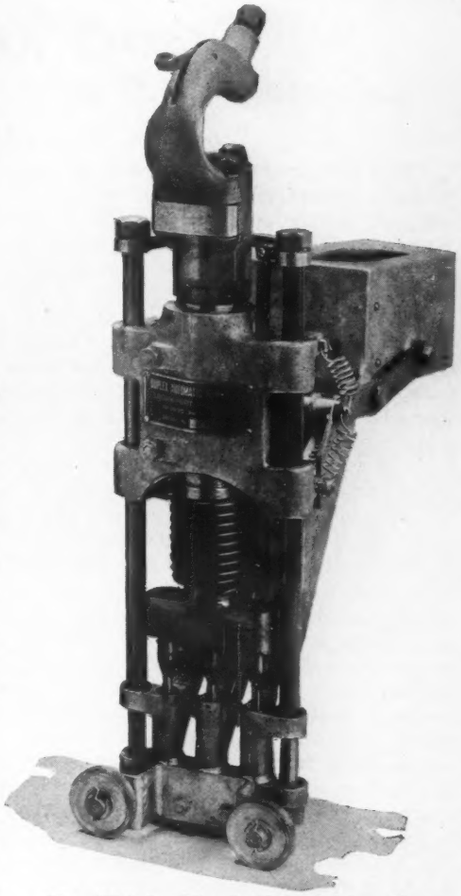
DRIVING NAILS WITH COMPRESSED AIR

ANOTHER labor-saving machine has recently been put on the market that should make a strong appeal to the man who now wields a hammer in driving nails and spikes for a variety of purposes. He will no longer have to suffer by reason of lack of skill on his part, because the new automatic nailer, manufactured by the Duplex Automatic Nailer Company, of Logansport, Ind., not only holds the nails but does the driving for him. The machine is operated by compressed air; and it comes in several sizes, with two or three barrels, to handle nails and spikes of different kinds. So far they have been constructed for vertical nailing only; but the company is now designing a type that will be able to drive nails horizontally.

The size known as the "Triplex Wonder", according to the maker, is suitable for any crating or boxing, and can drive from 3,000 to 3,600 cement-coated or common No. 6, 7, or 8 penny nails in an hour—hammering three in place at a time. Completely equipped, the "Triplex Wonder" weighs 65 pounds; and, being mounted on wheels, can be shifted readily from point to point.

It is claimed that a 78-pound machine, the "Duplex Automatic Floor Nailer", drives two spikes simultaneously in three seconds, including the time required to move the apparatus to the new working position by aid of the rollers, which are operated by foot pressure. This 2-barrel type uses spike nails ranging from the No. 20 to the No. 60; it has an over-all height of 43 inches and a width of 21 inches; and is especially designed for shipbuilding and for work on freight cars, bridge and hardwood floors, etc., calling for vertical nailing.

In service, the nails to be driven are placed in the hopper, shown in the accompanying picture. This hopper is provided with suitable slots through which the nails are automatically fed to nail pockets. The driving and operating mechanism is a No. 9-C air hammer which is securely mounted in two crossheads and can be moved up and down freely on guide rods by the operator—the weight being taken by springs. The upward travel of the crosshead assembly causes two or three nails, as the case may be, to drop head uppermost into as many nail pockets. That done, the operator lowers the crosshead assembly until the nail sets rest on the heads of the nails, and then he drives them by simply turning the throttle valve that releases the air. In the case of the "Duplex Automatic Floor Nailer", air at a pressure of from 90 to 120 pounds is used.



The "Triplex Wonder" that drives three nails at one stroke.

COLORING CEMENT

A NEW method of coloring cement has been devised by an Edinburgh chemist, states the *Stone Trades Journal*, in order to make homes of this otherwise drab-looking material more pleasing to the eye. Instead of putting color in the mix, or painting the structure after its completion, the walls are first well dampened with a stream of water and next covered with a dry, cement-like powder—of any desired color—blown on by a suitable spray gun.

Demonstrations have established, so it is reported, that the powder combines with the water and adheres to the rough surface, forming a permanent coating that is also waterproof. It is understood that many other building materials—such as metal, wood, and stone—can be similarly treated.

An average of 131 pounds of fuel was required in 1927 to haul 1,000 tons of freight and equipment—including locomotive and tender—a distance of one mile. This is 6 pounds less than the best previous record established in 1926.

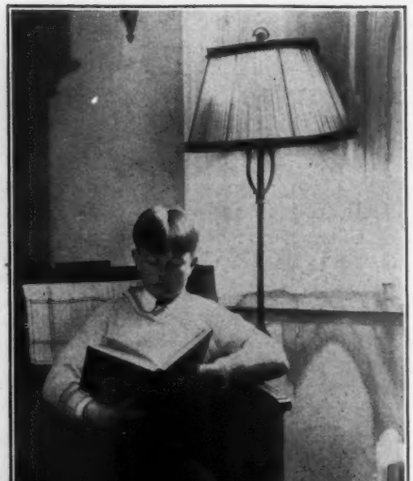
Good Light and Good Sight

By LEWIS H. CARRIS*

SCIENTISTS tell us that human eyes, commonly referred to as the windows of the soul, are simply protrusions of the brain. Both scientists and laymen are agreed that the eye is not only the most complex but, probably, the most valuable organism of the human body, and certainly one that most readily accommodates itself to diverse conditions. Because our eyes are so accommodating—automatically adjusting and readjusting themselves many thousand times a day without any conscious effort on our part, and because they may be long overworked before giving any sign of being tired, they are also the most frequently abused organism of the body. Much of this abuse of the eyes may be traced directly to their use under improper lighting conditions.

First of all, let me ask and answer the question: "What is good light?" Any light may be good—whether it be sunlight, gas light, or electric light—provided there is enough of it, that it is steady, and that it is properly shaded or diffused. No light is good—whether natural or artificial—if it flickers or is unsteady, if it is of insufficient or of too great intensity, if its source when level with the eye is unshaded, or if it produces glare.

It is, for instance, just as harmful to read a newspaper in broad daylight on a surface car while the car is going over a bridge or through business sections as it is to read it in a train when the lights are unsteady. The intermittent lights and shadows thrown across the page by the bridge superstructure or by the tall buildings cause as much eye strain as does the flickering artificial light. Again, it is just as harmful to read or to do other exacting work with an unshaded light hanging directly before the eyes as it is to do such work in a dimly lighted room. In either case, the muscles of the eyes are strained. Yet there are hundreds of homes, shops, offices, and stores in which people are carrying on their daily tasks either in dimly lighted rooms or with unshaded gas or electric lights before their eyes.



The right way to read with a good light falling from behind and over the left shoulder.

That this condition should persist is surprising in view of the fact that innumerable independent investigations—made by the National Committee for the Prevention of Blindness, the National Safety Council, and the American Museum of Safety, as well as by the Illuminating Engineering Society, the lighting industries, and various Government bureaus—all clearly show that proper lighting leads to more and better work; decreases accidents, mistakes, and waste; and increases the chances for health and happiness.

The important things to remember about lighting are:

Have all lights shaded; neither read nor work with a strong light shining right into the eyes; whenever possible, have the light fall on your book or your work from above and behind or from one side; if you are not able to read easily with the printed page 12 to 15 inches from the eye, then there is something wrong either with the light or with your sight.

Today, lighting companies give free expert advice regarding proper lighting of homes, offices, and other places of work. In most cases, however, careful attention to local conditions and the exercise of common sense will lead to the correction of many lighting defects. Good light is now available at small cost. Sight, on the contrary, is of inestimable value, and once it is lost or impaired cannot ordinarily be restored.

*Managing Director, National Committee for the Prevention of Blindness.

Photos, courtesy The New York Edison Company.

Left—An unshaded light like this, hanging in the range of vision, frequently causes eye strain that may lead to serious trouble. Right—When it is necessary to work with a light in front, it should be shaded so that the filament cannot be seen.

History of the Hecla Mine

Fine Work Done After Destructive Fire to Re-equip the Property for Operation

PART II

By E. L. WOOD*

ON Friday, July 13, 1923, the Town of Burke, Idaho, was completely destroyed by a fire that swept it from end to end. The buildings of the Hecla Mine, situated in that community, were reduced to ashes with the single exception of a big reinforced-concrete structure in which were housed the fire pump, the central heating plant, and the electrical department.

Around that surviving building, as a nucleus, was begun the work of putting the Hecla Mine in a state to resume operations. The outcome was the creation of a notably up-to-date mine plant that is rightly pointed to with pride by the people immediately concerned. The accompanying installment of our story about the Hecla Mine tells how this transformation was effected.

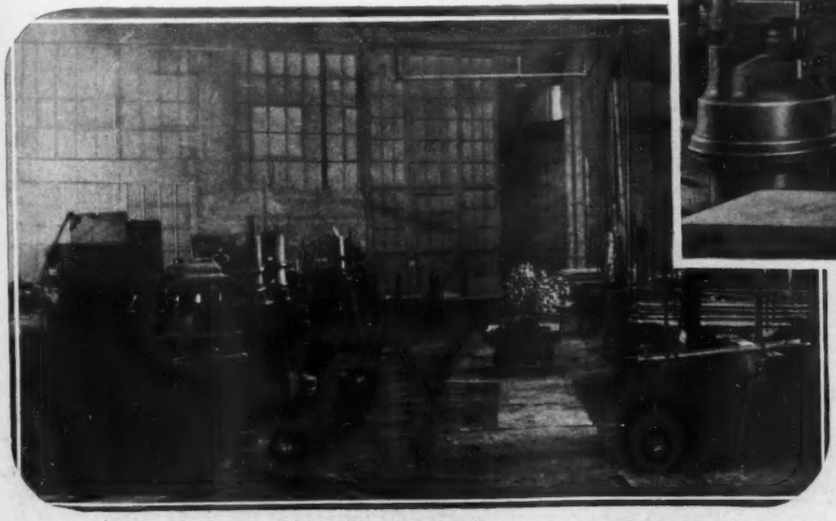
IN attempting to summarize briefly the reconstruction of the Hecla plant after the fire, three important facts must be held in mind, namely: that it was a hurry-up job with the shadow of the insurance company in the background; that the working space in the narrow Burke Canyon was restricted; and that two-thirds of the plant had to be built on filled-in ground. Construction was carried on without interruption through the following winter; and adverse weather conditions contributed many obstacles ordinarily not encountered in mining operations.

The first problems that presented themselves for solution immediately after the fire were those of organization and policy—that is, it was necessary to create an efficient construction gang out of a mining crew and to determine the type and the extent of the surface plant. The nucleus of the new organization consisted of mine employees—25 per cent of the old working force remaining to do construction work. Permanent, fireproof structures were decided upon. As far as possible, the general arrangement of the new plant was to be like the old one, with the exception that it was to be enlarged 100 per cent in anticipation of the demands that would be made upon it when the Star Mine was ready to begin operations.

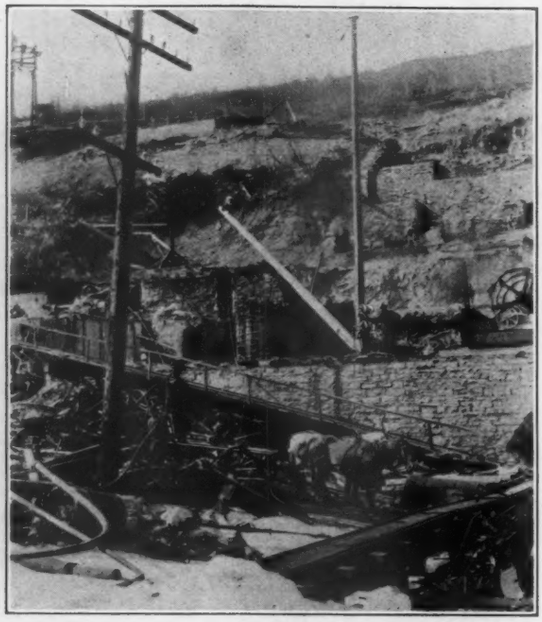
Cleaning up the wreckage was a big task. Just how big it was can be appreciated when it is known that 30 carloads of scrap iron and steel were shipped from the property. In re-establishing transportation facilities, a previous disadvantage in the system in the form of a steep grade on the high line was done away with by removing 1,600 cubic yards of solid rock. It was possible to make this improvement because the fire had destroyed all the buildings in the Town of Burke lying immediately below. The largest excavating jobs were those for the creek conduit and the ore-bin foundations, and involved the disposal of 10,000 cubic yards of material. This work was finally accomplished by a dragline excavator which was rented for the purpose after various other methods had been tried without success. What had at first seemed a difficult situation was thus handled with comparative ease and dispatch. All told, 19,100 cubic yards of earth and rock were removed—the remaining 7,500 cubic yards being made up as follows: Foundations for head-house buildings, 400 cubic yards; conveyor galleries, 2,500 cubic yards; mechanical buildings, 4,000 cubic yards; miscellaneous, 600 cubic yards.

Under the building program, as outlined, the headframe was the first to be taken in hand; and a contract was promptly awarded to the Union Iron Works of Spokane, Wash., for a fireproof, steel structure, agreeably to the policy adopted. After collecting the necessary data, H. J. McCamey set about designing the headframe, which was erected by a crew from the Illinois Steel Company. In this work some difficulty was experienced when two of the lower members of the frame were found to run through the dry house. It was necessary to splice these members around concrete beams that could not be cut. Once the headframe was well above the dry house no further trouble was encountered.

*Superintendent of Construction.



Views of the well-equipped blacksmith shop at the Hecla Mine. A battery of air-driven "Leyner" sharpeners serves to keep in condition the large number of drill steels used underground.



In clearing the way for reconstruction work at the Hecla Mine after the fire, in 1923, "Little Tugger" hoists proved helpful aids.

The headframe measures 134 feet 2 inches from the shaft collar to the center line of the sheaves. It was planned for a rope pull of 100,000 pounds and for a new hoisting installation, which accounts for the present location of the ropes inside the back legs. Complete, the structure contains 200 tons of steel; and 200 cubic yards of concrete were poured in the footings. It was designed, fabricated, and erected in less than six months.

The company was fortunate in being able to purchase from the Granby Smelter at Grand Forks, British Columbia, 160 tons of fabricated steel for buildings that could be used to advantage. This helped measurably to shorten not only the period of reconstruction but also the period of the mine's enforced shutdown. The first shipment of this structural steel arrived in Burke just 40 days after the fire. Thus the widths of the new buildings of the Hecla were determined by the widths of the roof truss spans supplied by the Granby Smelter.

Concreting was started on the rear retaining wall of the compressor house. This wall called for 200 cubic yards of material, and an additional 200 cubic yards of concrete was poured in the two compressor foundations. Since then another compressor, with a capacity of 4,300 cubic feet of free air per minute, has been bought, making three in all with an aggregate capacity of approximately 8,900 cubic feet of free air per minute. A total of 1,500 cubic yards of concrete was used for the head house which is 40 feet wide and, together with its basement, provides 20,000 square feet of floor space for work and storage.

Extensive repairs were also necessary on the dry house to restore it to usefulness. This structure has recently been enlarged to more than double its former size; and new wash and shower rooms have been added. The concrete bin at the shaft came through the fire undamaged. But, to make it fireproof throughout, its wooden superstructure was taken down and a concrete one built instead. The capacity of the Hecla Mine section of this superstructure has been increased from 500 to 900 tons, and the central waste section from 350 to 500 tons—the Star Mine section remaining as before. For this work were required 380 cubic yards of concrete.

At the same time was erected an ingenious contrivance that distributes the ore and the waste into their respective bins. It consists of a steel-plate apron with a swinging member at the dump and a deflection gate at the waste bin—the Star ore being carried above the Hecla ore and the waste bins. This apron weighs 10 tons, and was designed and fabricated at the Hecla plant. Below the ore bins is located the Hecla coarse crushing plant. The Star Mine has a similar installation on a still lower level. A 20x36-inch Traylor jaw crusher that had been ordered before the fire fitted admirably into this new order of things. It might be of interest to mention here that there was a small quantity of ore in the Hecla bin when the fire broke out. When the first carload of ore was subsequently taken out, it was found to contain 500 pounds of nails that had fallen from the burning structures.

The mechanical building at the west end of the plant has a floor area of 16,000 square feet and houses the blacksmith and the machine shops besides serving as a general warehouse. The south side of this structure forms a retaining wall, thus leaving considerable space for plant expansion. All piping and heating fixtures are carried beneath the floor in a tunnel, which connects with the central heating plant located in the lower part of the electrical engineering building. This concrete-and-steel building survived the terrific heat of the fire, in fact was found to be almost intact.

In laying out the shops the thought of increased capacity was also kept in mind. In the steel-sharpening shop, for example, there are now five sharpening machines capable of taking care of all the drill steels for both the Hecla and the Star mines in one shift. One thousand drill steels can be reconditioned daily with ease. The structure is 300 feet long and 54 feet wide, and contains 2,100 cubic yards of concrete.

Two conveyor ways have been erected that handle the Star and the Hecla ores separately from the coarse crushers to the loading bins and the sorting plant. Where the galleries go down through the dump it was necessary to pour 600 cubic yards of concrete. This job called for the excavating of 2,500 cubic yards of loose material, and required an elaborate system of shoring to hold the 30 feet of fill while the lower portions were being formed and poured. The upper parts of structural steel, weighing 3,500 pounds, were designed and fabricated by the Coeur d'Alene Hardware & Foundry Company of Wallace, Idaho, and put up by the Hecla crew.

The lower or Star conveyor has a vertical angle of 12° and is 225 feet long. The upper or Hecla conveyor has a vertical angle of 16° and is 240 feet long. Each belt is 24 inches wide, and travels at a speed of 250 feet per minute with a maximum load of 1,000 tons in eight hours, or 17 pounds per linear foot of belt. The Hecla conveyor transports ore to the sorting plant for treatment, while the Star conveyor delivers mill feed direct to the bins for dumping.

While this work was in progress two other construction jobs of almost equal magnitude were underway below the creek level, namely,

Change and dry room provided for workers at the Hecla Mine.

Stoping with an R-51 drill in the Hecla Mine at the 2,000-foot level.

the creek conduit and the loading bins. Canyon Creek had always been a troublesome factor in laying out the plant because it required a valuable passage through the narrow canyon and the maintenance of 50 feet of cribbing to hold the fill. The problem of eliminating both creek and cribbing proved a difficult one. Three choices were offered: a concrete retaining wall; cedar cribbing; or a conduit. The first was impractical; the second presented a fire hazard; and the third was decided upon as the best solution.

A conduit to carry the water at flood periods was an expensive proposition. But after weighing the cost against the advantages, H. C. Bender, of the Washington Water Power Company, of Spokane Wash., was commissioned to design the structure. The conduit is 1,100 feet long, and consists of three units: the inlet, the conduit proper, and the outlet. Combined with the inlet is the Canyon Power & Light Company's inlet for its 30-inch concrete pipe paralleling the conduit. The sectional area of the conduit is, roughly, 40 square feet. The main is 7 feet high and 10 feet wide at the base; and 1,600 cubic yards of concrete and 50 tons of reinforcing steel were needed in building it. Dennis B. Wood, of Spokane, was in charge of construction—this being the only part of the work to be let under contract. It took three months to complete the conduit, which now handles the flood waters in the springtime and, incidentally, has made for improved sanitary conditions in the canyon. Before the fire, these were at times almost intolerable, especially at the intake.

Construction on the ore bins was begun early in the fall of 1923; and, in line with the general plan, the original timber structure gave way to one of concrete with increased capacity. The foundation loads are applied over a total area of 4,800 square feet, giving a soil pressure of 2½ tons per square foot. The foundations were raised to track level, and required the use of 600 cubic yards of reinforced concrete.

Operations above the track level were started later that same season, making it a cold-weather job. For that reason the structure had to be heated continually and protected with tarpaulins at all times. To build the bins as a unit would have taken at least six months of intensive work. It was therefore deemed advisable to concrete sections on 50-foot centers at a point where the conveyors would land. The design of the structure is unique in that provision had to be made for its continuation both east and west.

Above the Hecla bin is a sorting and fine crushing plant consisting in the main of two Traylor 6-inch gyratory crushers and two picking belts. The arrangement is such that either one of these paralleling units can be operated independently in case of emergency. All the machinery is driven by individual motors. The Hecla bin has a capacity of 4,000 tons and is divided into four compartments: two mill-ore bins separated by a waste-ore bin and a crude-ore bin. The Star bin holds 2,500 tons, making a total capacity of 6,500 tons.

The ore bins have an over-all length of 200 feet, a width of 35 feet, and an average height of 60 feet. This does not include the sorting plant, which is 36 feet high. All told, they contain 3,000 cubic yards of concrete, 270 tons of reinforcing steel, and 60 tons of structural steel; and, roughly estimated, they weigh 12,500 tons. The plans and the designs were prepared by H. I. Cawthra, of the Hecla engineering department, under the supervision of Mr. Bender and J. C. Sharp, both of the Washington Water Power Company.

While the major building program was being pushed to conclusion, numerous lesser jobs were going on here and there about the property. These included the stull yard and saw mill, powder and fuse houses, office building, carpenter shop and rope house, heating-tunnel connections, sewer and steam lines, skip-changing device, etc. A good idea of what this part of the work involved can be had from the following list of materials, given in round figures: 440 tons of structural steel; 450 tons of reinforcing steel; 40 carloads of form lumber; 160 carloads of sand; 210 carloads of crushed stone; 63,000 sacks of cement used in pouring 8,000 cubic yards of concrete; 11,300 feet of sewer pipe; 74,000 square feet of roofing material; 245 steel window sashes; 56 steel doors, etc.

This story would not be complete without some mention of the great assistance rendered after the fire by different adjoining mines. The compressed air line of the Hercules Mine was tapped and connected to that of the Hecla; the Morning Mine furnished sand and gravel; and the Bunker Hill and Sullivan Mine provided timber for a small headframe and, besides, sent a temporary hoist as well as its electric crane for service in Burke. The mechanical and the electrical shops of the Hecla also co-operated fully, and lent their aid as needed under the general supervision of J. B. Sloan, master mechanic.

That the building program was carried out substantially as originally planned reflects great credit on those responsible for it; and the Hecla plant, as it now stands, is classed with the finest in the mining industry today.

(To be concluded)

The wash room at the Hecla Mine has hot and cold water for the convenience of the men coming off work.

Tunnel Built in a Drydock

Then Precast-Concrete Sections Were Floated, Towed to the Site, and Sunk to Their Permanent Positions

By THE STAFF

OAKLAND and Alameda, neighboring communities on the eastern shore of San Francisco Bay, Calif., have been linked heretofore by a drawbridge crossing the separating estuary. Some while ago, the Government authorities ordered the removal of this much used bridge because it constituted an obstruction to free navigation of the waterway. It was, therefore, incumbent upon Alameda and Oakland to provide another transit artery that would furnish a route for vehicles, street cars, and pedestrians; and the solution lay in constructing a subaqueous tunnel of exceptional size and in doing this in an unusual way.

The method adopted called for the casting of eleven reinforced-concrete sections, each 203 feet long and 37 feet outside diameter, and of a twelfth section similar in all respects save that it was 42 inches shorter than the others. The walls of these sections are 2½ feet thick—leaving an internal space, for traffic, having a maximum width of 32 feet. The outstanding novelty of the procedure lay in the use of a drydock as a base in which to cast the different sections. This drydock was at Hunter's Point, on the opposite side of San Francisco Bay, and ten miles away from the line chosen for the tunnel beneath the estuary.

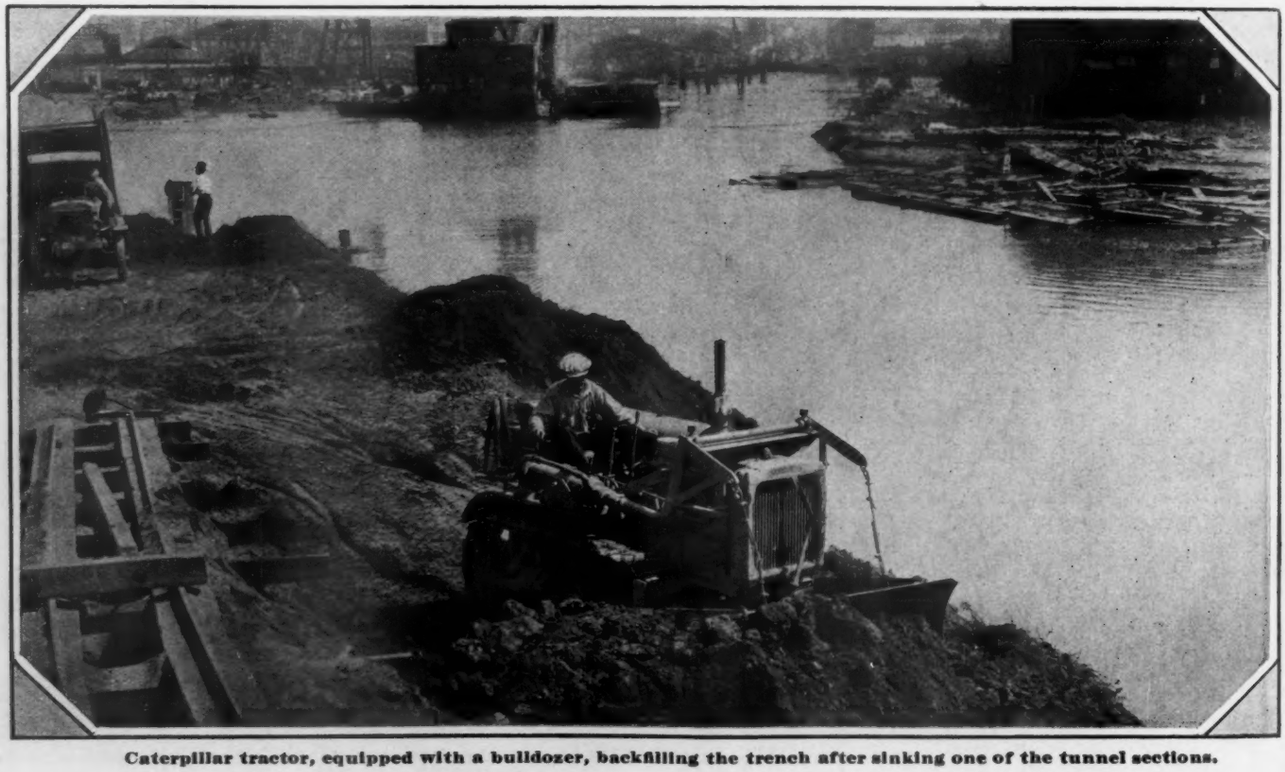
After each section was cast in the drydock, its open ends were bulkheaded to seal the cylinder so that it could be floated out of the drydock and towed thence to the position assigned to it in the underwater length of the tunnel. Arriving at its destination, the reinforced-concrete cylinder was brought to a predetermined position and so moored at symmetrically disposed points that it would settle precisely to its final resting place in a trench dredged to a maximum depth of 60 feet below the bottom of the waterway.

Each precast-concrete section weighed substantially 5,000 tons and drew 26 feet of water when floated free from the drydock. Three powerful seagoing tugs were used to tow the separate units from Hunter's Point to the estuary. Fully submerged, each section displaced 7,000 tons of sea water; and, therefore, 2,000 tons of ballast was required to overcome the reserve buoyancy so that the cylinder would sink. The ballast utilized consisted of 840 tons of water, let into the ventilating air duct below the roadway slab of the tunnel section, and of about 950 tons of sand spread 3½ feet thick on top of that slab. A still nicer control of the needful dead weight was obtained by spraying water on to the sand.

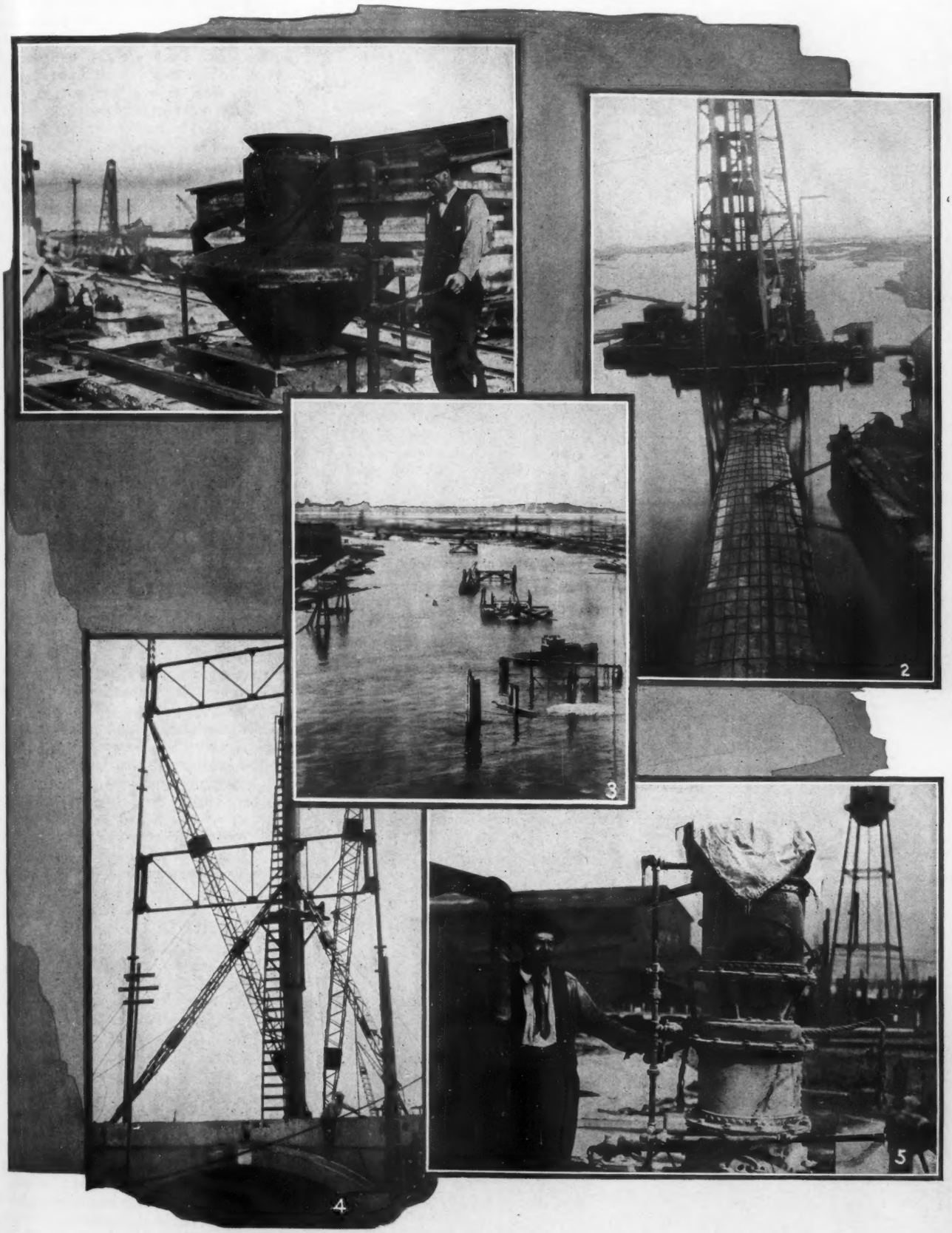
Concrete piers, 6 feet 6 inches in diameter and spaced at suitable intervals, were previously constructed in the bottom of the trench to receive the various sections. Where the ground was soft the foundation was stiffened by driving lines of closely spaced piles ballasted with crushed rock and tied together at the top with a blanket of concrete. The sections were further steadied laterally by a deep cushion of sand or clay, depending upon local physical conditions.

Most of the sections were straight cylinders, but three of them were curved so as to bring the tunnel in line with the centers of the two streets in Alameda and Oakland, respectively, thus joined. These curved sections proved troublesome to handle in the drydock and awkward to tow and to get into position afterwards for sinking. The amount of reinforcing steel and the number of associate stirrups in each precast section made it a difficult job to insure a dense concrete free from voids. It was impossible to tamp the concrete within the collapsible metal forms; and to induce the settling and the compacting of the mass the forms were vibrated by jarring them with pneumatic hammers.

The lining up of the sections during sinking was checked by surveying instruments above water and by divers co-operating through the medium of underwater telephones. When the opposing collars of the adjoining ends of two cylinders were at the prescribed distance

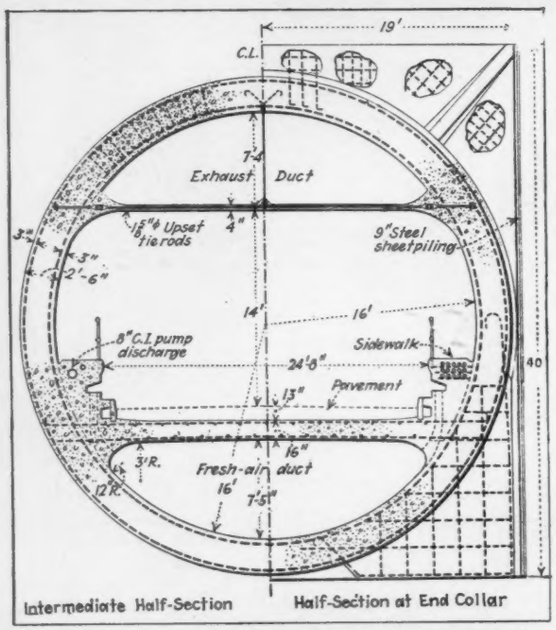


Caterpillar tractor, equipped with a bulldozer, backfilling the trench after sinking one of the tunnel sections.



1—Compressed-air apparatus used in shooting concrete to the inside joints of the subaqueous tunnel. 2—One of the reinforced-concrete tunnel sections lined up preparatory to sinking to position. 3—A section in place, only aligning masts showing above water. 4—Close-up of an aligning mast and the long manhole shaft that gave access to the interior of each section after it was sunk. 5—Machine used in placing neat-cement grout in the joints of the sections.

Pneumatic hammers were used to vibrate the metal forms so as to compact the concrete mass within.



Courtesy, Engineering Ne ws-Record.

Typical cross section of the vehicular tunnel between Oakland and Alameda.

apart, an annular connecting ring—made up of segments of ¼-inch steel plate—was assembled by divers to serve as the inner part of the form into which concrete was poured when the outer part of the form was completed. Neighboring sections were joined in this manner and the tunnel made a unit—interlocking, reinforcing steel giving each union its necessary measure of longitudinal and circumferential strength.

Compressed air was used to force grout into tiny fissures and other openings so as to insure the effectual stoppage of all leaks and seepage. The inside of each joint was finished by forcing concrete into place with compressed air. When the concrete in the joint had aged for a week, compressed air was forced into the mass to drive outward any water that might have penetrated it in the meanwhile; and, while the air pressure was maintained, neat-cement grout was forced into the mass to seal all spaces previously filled with water. This procedure also took care of any shrinkage that might have taken place in the concrete since it was first poured. In this way water-tight joints were assured.

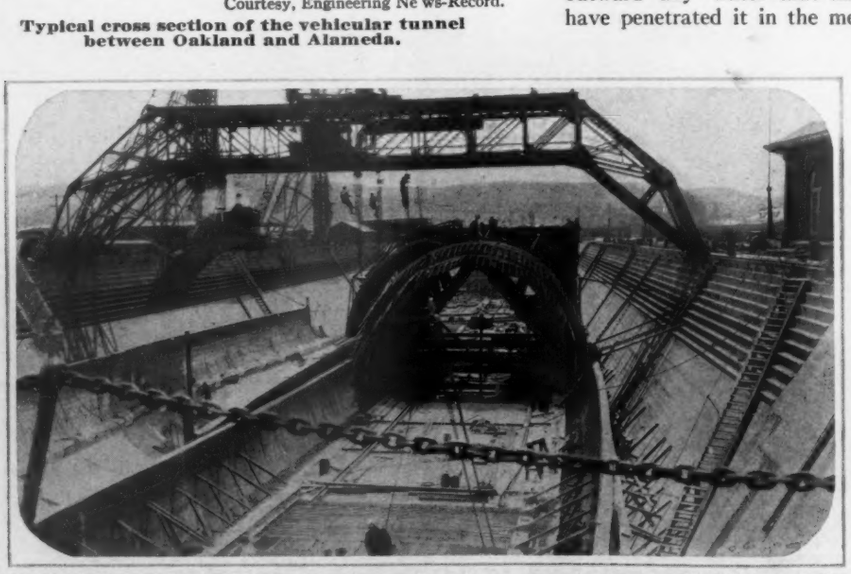
Each precast tunnel section was formed with a number of sand- and water-ballast openings, together with a single opening that gave the workmen access to the interior of the cylinder while it was being sunk and afterwards when it was in position in the trench at the bottom of the estuary. After the sections were in their final resting places, compressed air was employed to force cement into the openings so as to make the sections absolutely watertight.

In order to overcome the inherent buoyancy of the tunnel when pumped dry, it was necessary to backfill the trench and to pile upon the concrete sections sufficient earth to hold them firmly in their subaqueous bed. This backfilling was done, of course, before the sections were unwatered. With this completed, the sections were successively drained and the interposed wooden bulkheads, that had made it possible to tow them across the bay, were removed. Pneumatic tools were used to drill holes in the wooden sections of these bulkheads to make openings that would permit the utilization of saws to finish the work; and air-driven hammers and drills were employed to cut out the intervening sections of concrete. Air-driven pumps helped to do some of the unwatering.

The use of a drydock in forming the reinforced-concrete tunnel sections was an unusual engineering expedient, but it had a number of advantages. To begin with, it obviated the building of ground and launching ways and avoided the risks that otherwise would have been incurred when transferring such structures from land to water. It was necessary only to flood the dock at the proper time to float a tunnel section clear of the keel blocks and the other temporary supports upon which it was molded. Floated in this manner, without subjecting the cylinder to sudden bending stresses, it was a relatively easy matter, thereafter, to tow it to its intended permanent site.

Each tunnel section, cast in suitable collapsible forms, was poured in three separate operations. The first completed the invert or bottommost part of the structure up to the floor line; the second formed the floor slab; and the third pouring, constituting substantially two-thirds of the cylindrical shell, finished the arch. After the steel forms were removed from a newly cast section, the exterior surface was given a waterproof coating; and to safeguard this coating from damage during towing from the drydock, the section was lagged or covered with planking arranged longitudinally like the staves of a barrel. The planking was held firmly in position with steel rods, bent like hoops, that could be drawn tight.

The contract was awarded to the California Bridge & Tunnel Company in March, 1925; and the undertaking has been carried forward with commendable speed.



Hunter's Point drydock where the tunnel sections were cast, showing the specially designed gantry traveler for handling heavy materials and supplies.

Shongweni Dam Assures Durban an Abundance of Water

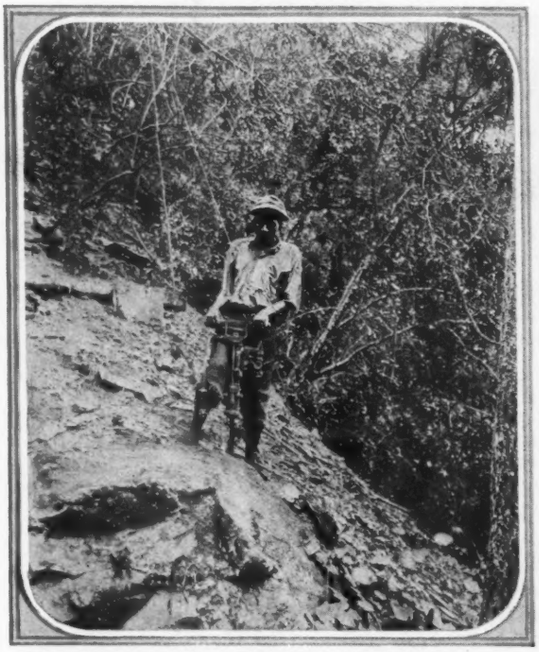
This South African City Recently Completed an Engineering Project of Outstanding Magnitude

By JOHN BURGESS

DURBAN, Natal, is one of the finest and most progressive of the cities of South Africa; and as a seaport it is of outstanding importance because of its position on the Indian Ocean. Durban is not only picturesque and attractive to the visitor but it has many charms and conveniences that make it a pleasant abiding place for its resident population. Of these conveniences, none is more vital to the citizenry than the up-to-date water-supply system; and it is with this feature of municipal administration that the present article is most concerned.

As a township, Durban or D'Urban, as it was once written, was organized by colonists in 1835; but we are not told where and how those early settlers obtained their water supply. However, when Durban assumed the proportions of a borough in 1854, one of the first corporate acts was to provide the community with a dependable source of water. This was done by the simple procedure of digging a more or less capacious well in the heart of the town. With that as a precedent, Durban continued to rely upon wells for its potable water until early in the "eighties". During the dry season in 1878, Durban was hard put to it for water, and supplies had to be transported to the community from the Umgeni River. This water was retailed at a penny a bucket.

In 1883, the Umbilo system was authorized, and four years later it was furnishing water to the town; but by 1890 it became evident that the Umbilo River was not a dependable source of water for rapidly growing Durban, and the original Umlaas system was planned and built. Floods in 1905 and 1917 did so much damage to the city's water works that it became urgently necessary to make larger and more up-to-date provisions for supplying the city with water. As a result, experts were consulted; and what is now known as the Shongweni (Umlaas) scheme was adopted and authority given to go ahead with its construction. Something like six years have passed since that momentous step was initiated looking to the further well-being of Durban.



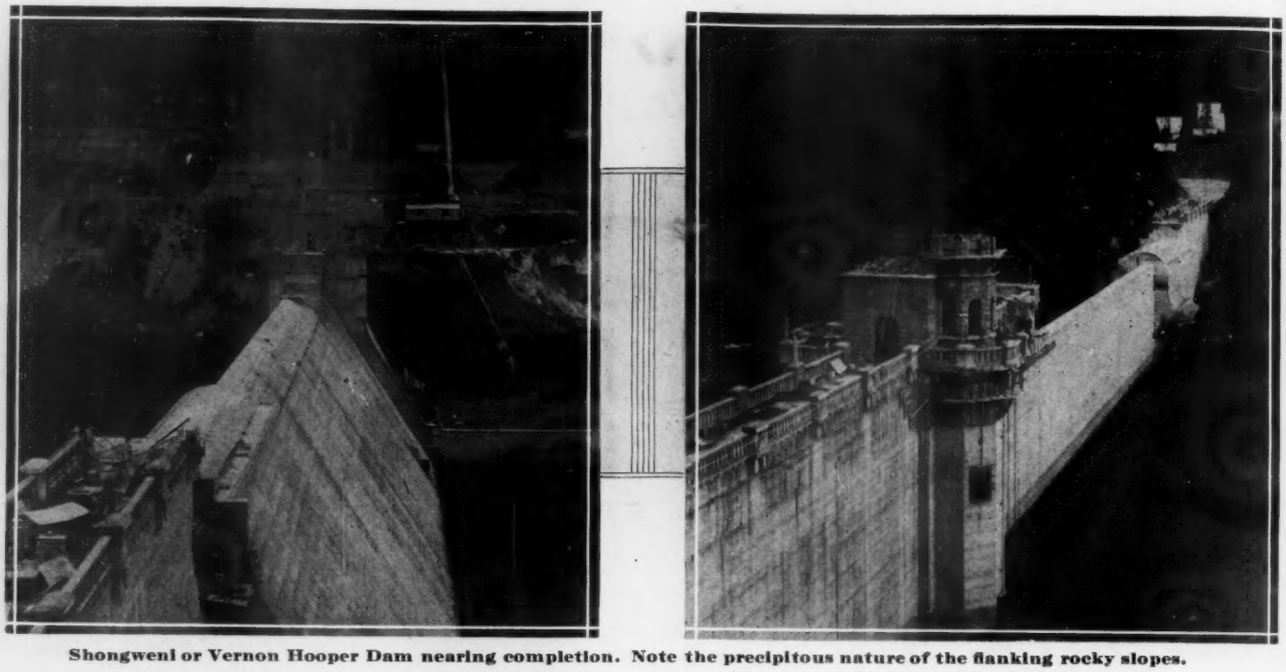
Drilling rock with a "Jackhamer" on a steep slope adjacent to the dam site.

In 1924-25 the borough narrowly escaped a water famine. Leaky water taps were watched, and householders were warned to use the available water sparingly. Today, by the mere turning of a valve, the community has at its disposal 17,000,000 gallons of water daily where before the completion of the Shongweni Dam the town could not count upon more than 7,000,000 gallons. The citizen may now sprinkle his lawn and flowerbeds freely; and a leaky spigot is generally a matter of indifference—such is the transformation that has been wrought by skillful engineering. As a writer in the *Natal Advertiser* has expressed it: "The name Shongweni, in the estimation of the people of Durban, stands and will continue to stand for a great deal more than a verdant river valley and a towering concrete dam. It stands for a fine achievement in modern water engineering, exemplifying all that is best in the conservation, purification, filtration, and delivery of man's most vital necessity—water."

The Shongweni Dam was wisely placed at a point where the main Umlaas River is joined with the Sterk Spruit and the Ugede. There the flanking hills have provided not only rigid anchorages for the two ends of the dam but also the sides of a natural bowl having a superficial area of 300 acres. When filled to overflowing, the reservoir—created mainly by nature and partly by man—is capable of holding 2,600,000,000 gallons of water, enough to meet Durban's present rate of consumption for a year or more.

The Shongweni Dam is 808 feet long from side to side of the valley it blocks, and its maximum height is 94 feet—the spillway being 87 feet above the level of the river bed. The spillway

Handy "Jackhamers" performed excellent service in helping to clear away the rock on each side of the river valley.



Shongweni or Vernon Hooper Dam nearing completion. Note the precipitous nature of the flanking rocky slopes.

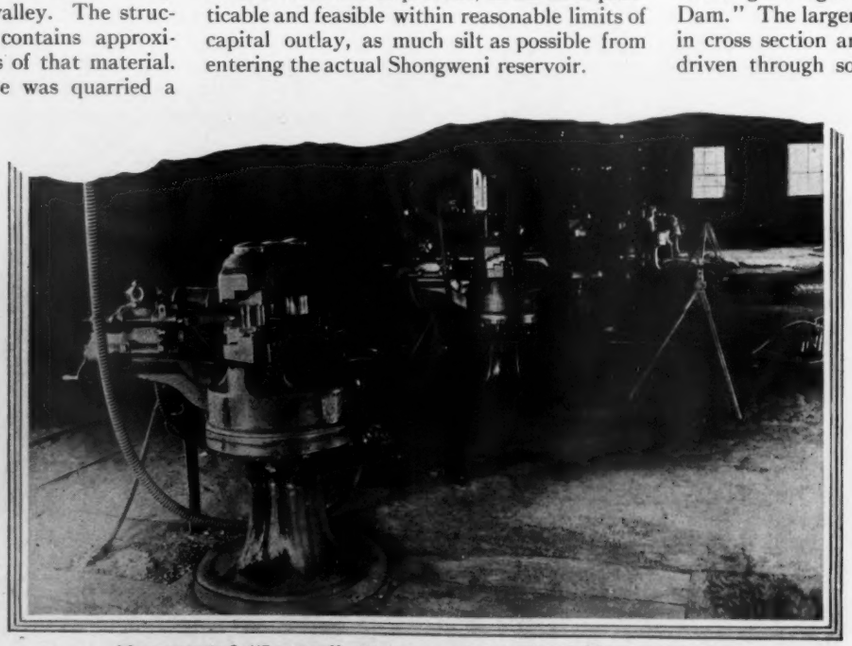
is 500 feet in length; and when the reservoir is full to overflowing the excess water will escape downstream over this part of the dam. At its base the dam is 70 feet thick, and it tapers to 8 feet at the top. The structure is surmounted by an architecturally effective valve tower in which are housed the valves controlling the distribution of the impounded water. At the right of the spillway, looking downstream, is the siphon system—something new in water engineering in South Africa. There are twelve siphons, and their action is automatic. Their purpose is to promote the removal of silt by increasing the velocity of the water flowing over the spillway.

The dam is anchored on the granite underlying the site, and is also tied to the rocky walls on each side of the valley. The structure is of concrete, and contains approximately 110,000 cubic yards of that material. The stone for the concrete was quarried a short distance upstream from the dam. In getting out stone from the quarry and in excavating the cut-off of the foundation numerous DCRW-23 "Jackhamers" were used; and the steels for the drills were kept fit for their work with several air-driven "Leyner" sharpeners. The blacksmith shop was also equipped with a pneumatic portable grinder. Operating air for drills, Cameron pumps, etc., was furnished by five ER-1 compressors.

Power is developed from the water impounded above the dam—the hydro-electric plant being situated below the dam and on the right bank of the river. The installation consists of a single turbine which generates electric current for lighting the entire undertaking and for pumping water that provides hydraulic power for opening and closing the main valves.

The following additional details regarding the system appeared in the *Natal Advertiser*. "The bugbear of water engineers the world over is silt. It is silt that is putting a period to the usefulness of the Camperdown Dam, 25 miles higher up the Umlaas. Silt will also tend to shorten the career of the Shongweni works unless, happily, the flood-diversion system introduced fulfills all that is expected of it. The principle that has been adopted for flood diversion is to prevent, as far as is practicable and feasible within reasonable limits of capital outlay, as much silt as possible from entering the actual Shongweni reservoir.

"In order to effect this purpose a flood diversion weir, 28 feet in height, has been built across the river at the upstream end of the reservoir. At times, when the river is comparatively free from suspended silt, the water will be allowed to pass over this weir to the reservoir; but when floods are sweeping their burden of sand and mud downstream, then will be opened large sluice gates giving entry to a canal, and the flood water will be passed therein. The canal, which is capable of conveying 1,100 cubic feet of water per second, is a mile in length; and at its lower end the water will fall down a 40-foot vertical shaft into a tunnel which discharges into a larger by-wash tunnel that penetrates the hill constituting the right flank of the Vernon Hooper Dam." The larger tunnel is 20 feet by 23 feet in cross section and 1,142 feet long. It was driven through solid granite, and this work was done with pneumatic rock drills.



Air-operated "Leyner" sharpeners kept the drill steels fit for the work required of them.

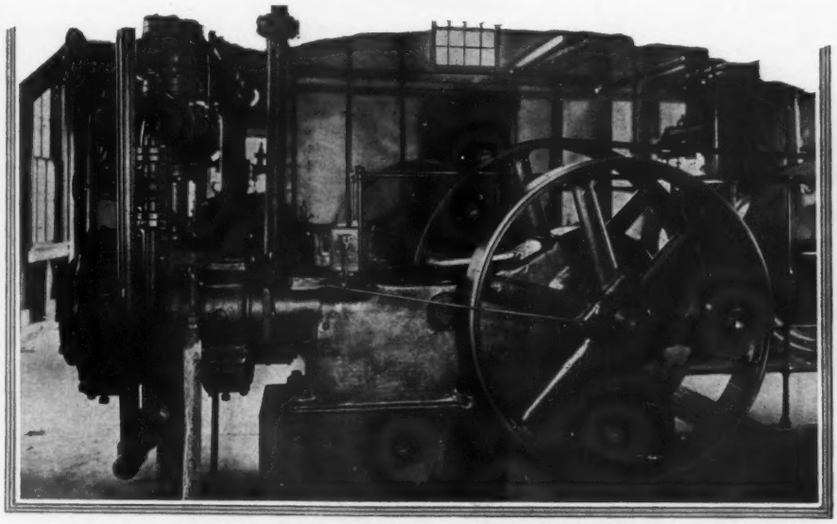
In explanation of the functioning of the tunnels, the paper said: "When the oncoming flood is in excess of the capacity of the canal, the surplus water will be passed down the river bed to the inlet end of the flood by-wash tunnel, where a sluice gate of massive proportions has been erected. Here the flow will be diverted and passed through this latter tunnel to a point downstream of the dam. The capacity of the larger tunnel is 8,000 cubic feet per second, which is sufficient to deal with a considerable flood. When

the flood is falling—which is the period of maximum deposition—all the flushing arrangements will be opened and will remain open until the burden of silt has been passed through. By this means it is confidently hoped that the life of the Shongweni works will be prolonged beyond the common span."

The formal beginning of service of the Shongweni or the Vernon Hooper Dam, as the structure is variously known, took place with suitable ceremonies on December 15, last, although it had actually served as a source of water supply for some time previously. The engineering fraternity will watch with keen interest the silt-disposal features of the dam, and profit by the revelations if they indicate the success expected. This problem is a persistent one for the water engineer, especially where rivers drain watersheds characterized by loose soils that are easily eroded during more or less frequent flood periods. At the present moment there are a number of large dams building or contemplated in regions of this nature in the United States.

The Town Council of Durban has shown both farsightedness and commendable enterprise in taking the steps which it has not only to insure a present abundance of water for that thriving city on the east coast of Africa but also to make certain that there will be plenty of water for a much larger community in the days to come.

In bringing this monumental undertaking to a climax, the men immediately concerned have labored without cease for years. Foremost among these should be mentioned the borough water engineer, Walter M. Campbell. Mr. Campbell was appointed to that responsible post in 1919; and thus for nearly nine years he has borne for the most part the directive burden of a task that has brought to Durban a typically modern water system capable of satisfying increasing demands.



A number of these Class ER-1 compressors furnished the air needed to run numerous rock drills and other pneumatic equipment used on this important undertaking.

A MILLION RIVETS A DAY

THE following interesting item appeared not long ago in the *Chicago Evening American*, and is further proof of the holding power of rivets:

"In far-off Japan, four years ago, nature rocked the earth with an awful shock that aroused the sympathy of the world. Buildings fell to the ground, and thousands of people were killed and maimed. Yet, through all this, some buildings remained intact. Those buildings had been built of riveted steel.

"The first rivets ever to be used were driven into place by hand hammers. The riveter of generations ago had to wield a 'nasty hammer,' and had to wield a hammer in each hand. The first riveting gun was used in 1875; and improvement rapidly followed improvement until, today, there are over 700 styles and sizes of riveting machines to fit every possible use.

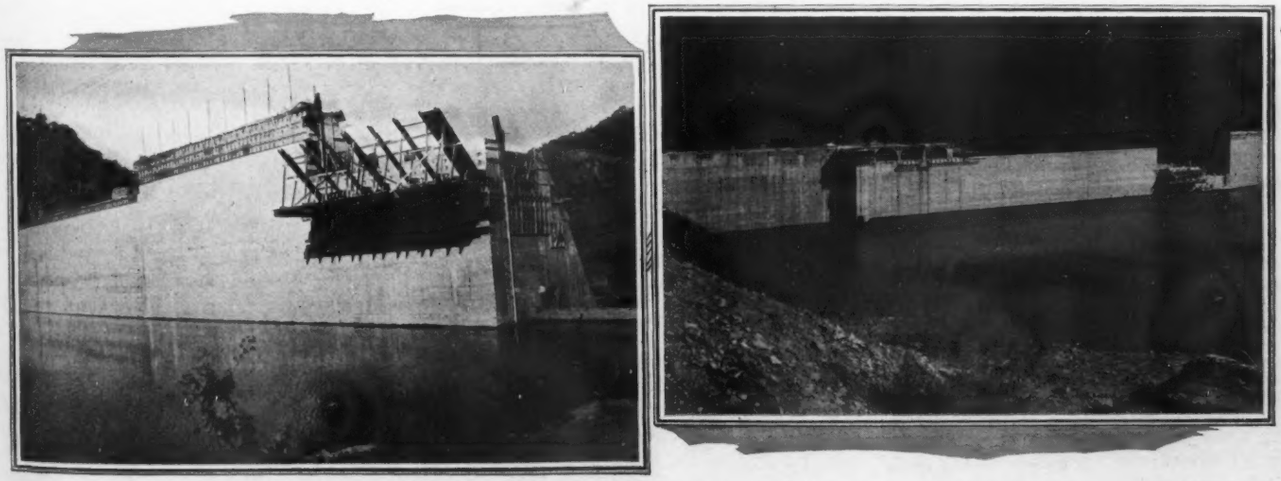
"More than 1,000,000 rivets a day are being driven in the United States alone. Each one is a bullet sent home, a bullet demonstrating man's ingenuity and resourcefulness. Rivets are found wherever industrial progress reigns. Besides their use on ships, skyscrapers, bridges, etc., they help to construct railroad equipment, boilers, tanks, stacks, automobiles, tractors cranes, agricultural machinery, etc.

"Wherever absolute safety and the ability to withstand unusual stress and strain are requisite, rivets are called in: They are the shock troops of the industrial battle.

"With the rivet as a cornerstone, the skyscraper of modern industry has grown as tall and reliable as it is today. With the 'put-put' of the riveting hammer as accompanying music, modern industry will march on to new triumphs and will grow to unheard of heights."

In the face of the foregoing facts it is not hard to understand why those that know best the value of riveting as a means of binding metal parts together say: "Riveting is Safe and Permanent."

Expressed in terms of coal, it would have required 1,922,318,409 tons of coal, so it has been estimated, to produce the energy developed in 1927 from the three principal sources of power—that is, coal, oil, and falling water. Coal, itself, was used to the extent of 1,422,482,866 tons, while oil and falling water equivalent to 363,762,300 and 116,073,243 tons of coal, respectively, were consumed in generating the energy needed to do the world's work.



How the Shongweni Dam appeared when construction work was far advanced.

LIGHT-WEIGHT PNEUMATIC CLAY DIGGER

TO meet the demand for a more powerful and a lighter tool, the Ingersoll-Rand Company, of New York City, has produced a new type of pneumatic clay digger that is said to be superior in power to any other air-operated clay digger of equal weight. This new machine is known as the Size 73, and differs in construction from those heretofore put on the market.

Lighter weight, combined with increased power, distinguishes this new air-driven clay digger from the earlier models produced by the Ingersoll-Rand Company.

Without the clay scoop, the Size 73 has an over-all length of 20½ inches and weighs 20½ pounds. According to the maker, it embodies a self-seating plate valve of the "flapper" type which is smooth and positive in its operation and becomes more tightly seated with continued use. Because of its light weight, short distance of travel, and its cushioned action, the wear on this valve is negligible.

The tool-holding device is also new, and is designed, first, to completely enclose the lower end of the barrel so as to prevent dirt from working its way up into it; second, to support the lower part of the shank of the blade; and, third, to facilitate removing and assembling, as the case may be, of the rubber buffer and the blade.

As it is a recognized fact that ease of handling speeds up operations, the lighter-weight Size 73 should prove of value in doing all manner of excavating in clay or kindred materials.

NEW METHOD OF DAM CONSTRUCTION

SOMETHING entirely new in dam construction, based on model tests, is being tried out in France, according to the *London Times Engineering Supplement.* Instead of a single either straight or curved wall, the new dam to be built at Marege, in the Haute-Dordogne, is to have five thin curved shells of reinforced concrete placed one behind the other and each shell lower than the one directly back of it. In this way the desired head of water will be obtained in five stages.

The idea is that when the reservoir is filled, the water in the intervening spaces will help to support the walls. In other words, only one-fifth of each shell, and that at the top where the pressure is least, will be subjected to pressure acting in just one direction. The first four walls are to be of uniform thickness throughout. It is believed that by thus making some of the water act as a counterweight, an economy of more than 25 per cent in building materials alone can be effected.

CARL RUDOLPH NYMAN

WE regret profoundly to announce the death, on May 26, at Tulsa, Okla., of Carl Rudolph Nyman. At the time of his demise, Mr. Nyman was only 33 years old but he had, nevertheless, won for himself an enviable position in his chosen field of activity. He had devoted much time to the study of petroleum-production problems, and was considered an oil-field engineering specialist.

Mr. Nyman was graduated in June, 1920, from the University of Michigan, where he had taken the mechanical-engineering course. The following year he entered the services of the United States Bureau of Mines and was assigned to the helium repurification plant at Langley Field in Virginia. In July, 1923, he joined the student's training course of the Ingersoll-Rand Company, and in January of 1924 he became a member of the Engineering Department of that company at its head office in New York City. Subsequently, he was detailed to the General Sales Department, where his training and natural aptitude revealed his fitness for still more important duties.

As recently as March 12 of the present year, Mr. Nyman assumed the responsibilities of acting manager of the company's office in Dallas, Tex.; and it was while on a trip to Tulsa, in his administrative territory, that he was suddenly stricken with the illness that brought his very promising career to an abrupt close. He will be greatly missed by his many warm friends as well as by the admiring acquaintances made by him during his relatively brief but decidedly fruitful years.

Upon examination it has been discovered that the famous Leaning Tower of Pisa, in Italy, is being undermined by subterranean springs. To keep the water at bay and to reinforce the foundation it is proposed, according to *Ice and Refrigeration*, first to freeze the ground beneath the structure by the aid of refrigerating machinery; next, to build a waterproof circular wall, 36 feet deep, around the foundation; and, with these things done, to force grout into the well so built.

By a German process, anywhere from 75 to 100 gallons of dye are required to color the wood of an average tree while still standing. Holes are drilled in the base of the trunk, and these are filled with the fluid fed from an overhead tank. The circulatory system of the tree, itself, does the work of distributing the dye—uniformly coloring the wood throughout.

What is said to be the world's second largest automatic power plant has recently been completed in British Columbia at an expenditure of $2,500,000. This is the Alouette hydro-electric station of the British Columbia Electric Railway Company. The single generator in this plant, which will be capable of adding 12,500 hp. to the system, is controlled from the Stave Falls power house, which is 11¼ miles away.

Yucatan, Mexico, produces approximately 75 per cent of the world's henequen, so extensively used in the manufacture of twine.

New Zealand, with a population of a little more than 1,400,000, imports annually from the United States goods valued at $40,000,000, or nearly $29 worth per capita.

The Central Vermont Railway has put into service a type of open freight car that has been especially designed to transport the immense granite slabs quarried in that state for monumental and other purposes. The car has a nominal capacity of 50 tons, and the cradle of the well, that resembles two large bridge spans, will take a slab 22 feet long, 3 feet thick, and having a maximum width of 13 feet 8 inches.

The reproduction of entire operas or the reading of books by phonographs without the troublesome changing of disks may soon be an accomplished fact, according to an announcement from the General Electric Laboratories, at Schenectady, N. Y. Work is in progress there on a long-running machine that makes use of films instead of the familiar wax records. The films, it is said, will make it possible to run a phonograph without cease for as long as two hours.

It is estimated that the asbestos deposits of the Pietersburg district of South Africa contain more than 3,000,000 tons of the material.

An ingenious method of handling ore in a stope that is not steep enough to permit the material to slide down by gravity was described not long ago in the *South African Mining and Engineering Journal.* Two wire ropes were stretched between the working face and the box into which the ore was to be shot. On these ropes was run a steel tray, mounted on four wheels, open at both ends, and 6 feet long, 20 inches wide, and 6 inches deep. This trough was loaded with about 500 pounds of ore and permitted to roll down to the bottom, where it was stopped abruptly by buffers causing the load to be shot out into the box. Three boys, it is said, were thus able to handle more than 30 tons of ore per shift.

What is claimed to be a record in shaft sinking in South Africa was made not long ago, it is reported in *The Engineer*, at the Springs Mines' No. 4 vertical shaft. Working in three shifts, and using Ingersoll-Rand drills, a sinker and a helper, with a gang of 42 boys, lowered the shaft a distance of 286 feet in 31 working days.

Compressed Air Magazine

—*Founded* 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:

Bowling Green Building, No. 11 Broadway, New York City
Tel. Bowling Green, 8430

Publication Office: Phillipsburg, New Jersey

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

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EDITORIALS

GREAT NORTHERN TUNNEL HOLED THROUGH

ON the first day of May, President COOLIDGE, in Washington, pressed the button that set off a charge of dynamite in the bowels of the Cascade Mountains—the purpose of the blast being to break down the last rocky barrier in the pioneer tunnel of the still larger associate tunnel that the Great Northern Railway is driving, for a distance of 7.79 miles, through those mountains between Berne, on the east, and Scenic, on the west. The shattering of that final wall of rock in the pioneer tunnel opened a passageway from one side to the other of the range, and brought just that much nearer to completion the longest railroad tunnel under construction in North America.

Work on this titanic task was started on December 1, 1925; and A. Guthrie & Company Inc., the contractors, have advanced their operations with extraordinary rapidity. Some astonishing records have been made during various stages of the undertaking. In the course of 31 days, for example, an 8x9-foot heading was carried forward 1,157 feet—representing the removal of 3,085 cubic yards of rock, while a 10x10-foot heading was advanced 984 feet in a similar number of days and involved the removal of 3,644 cubic yards of rock. In ring drilling the main 18x25-foot tunnel, 1,220 linear feet of enlargement was made from a 10x10-foot center heading during a single month.

These achievements show what skillful organizing, efficient equipment, and keen competitive efforts among the various gangs have made possible. The records also show what can now be done with up-to-date air-driven rock drills. Both the contractors, who are doing their work so well, and the Great Northern Railway, which is ultimately to benefit by that work, are to be congratulated upon what has been accomplished to date. The performance is one well calculated to arouse world-wide interest.

When completed, at an estimated total cost of $10,000,000, the railroad will have to climb to a point 501 feet lower than at present in getting across the Cascade Range; the route will be shortened 7.68 miles; and passenger trains will save one hour, while freight trains will make the run between Scenic and Berne in two hours less time than is now possible. Even though the tunnel will be the means of effecting substantial operating economies on the part of the Great Northern Railway, still, in the last analysis, it is being built for the benefit of the traveler and the shipper.

OUR AIR MAIL ROUNDS OUT DECADE OF SERVICE

HOW many of us realize what the red-white-and-blue boxes for air-mail postal matter represent in the way of milestones of progress?

On May 15, past, the United States Air Mail Service was ten years old; and, when started in 1918, the first and only route was between New York and Washington—flying being done exclusively during the hours of daylight. Even when the service was extended for the carriage of first-class mail between New York and San Francisco it was a dual operation—trains transporting the letters during the hours of darkness while the planes performed their part only in the daytime. Even so, the transcontinental trip was reduced from 87 hours to between 50 and 60 hours—depending upon atmospheric and weather conditions.

Today, the routes have an aggregate length of 9,916 miles; and the plan of the Post Office Department is to increase this shortly to 11,621 miles. In fact, by the end of the current year we are assured that mail matter may be dispatched by air to any of the 48 states forming the Union. At the present time, there are 22 airways in operation; and every day mail pilots fly a total distance of 22,110 miles, carrying on an average each 24 hours substantially 5,700 pounds of postal matter. They do this by day and by night, in fair weather and in foul. Bearing in mind how experimental was the nature of the undertaking in 1918, and recalling the physical and the engineering difficulties that had to be surmounted to warrant legislative support and to justify continuance, what has been achieved since is highly creditable to every one concerned.

Without the least tendency towards boastfulness, it may be justly claimed that the transportation of mail matter in the United States by airplane is far ahead of kindred activities in any other country. It is undeniable that this service is of incalculable benefit to the nation at large; and very properly we may speculate as to the outcome in the course of the next ten years. If progress be as rapid and development as great as it has been in the last few years, then our air mail holds for us amazing possibilities.

EVER-WIDENING SERVICE OF INDUSTRIAL RESEARCH

IT has been said that American industry spends annually in research the tremendous sum of $200,000,000. Amazing as this outlay is, still there is ample warrant for the expenditure and plenty of evidence of substantial benefits. Indeed, this helpful work must go on; but it is only fair to the ultimate consumer, who of necessity must pay the bill, that he be informed just how he gains by these costly investigations.

To this end, the American Research Council is making a survey which has for its purpose the gathering of information covering just what research has accomplished for industry so that the facts can be published for the enlightenment of 15,000,000 investors who furnish essential monetary support for the nation's manufacturing concerns. The forthcoming information should be equally welcome to the public at large, who, in turn, will be that much more likely to contribute needed funds to our industrial enterprises intent upon expanding or planning the betterment of their productive facilities.

As has been well said by ARTHUR D. LITTLE, one of our foremost exponents of industrial research, "The price of progress is research, which alone assures the security of dividends. Progress is made not by raising tariffs, but by devising new methods, new equipment, new organizations for operation, distribution, and control." As a direct outcome of co-operative research, the following single example is indicative as well as illustrative of the benefits that may be so derived. We quote from a news item recently furnished by the Policyholders' Service Bureau of the Metropolitan Life Insurance Company:

"About five years ago, in New England, a live and representative group of business men in non-competing lines organized among themselves a research association. Eleven companies comprised the group, which included a machine-tool builder, a publishing house, a chain cotton-mill owner, a tanner, a textile-machinery house, a rubber-goods manufacturer, and several others. The annual value of their combined products totals more than $150,000,000. They pool business information and exchange intimate facts about their methods and costs. They are candid about their errors and shortcomings. Their staff members compare notes with one another: they make rounds of inspection of one another's places of work. Profitable ideas come from facts in the possession of the team members, and these are assembled for the common good. An irrefutable illustration of the value of this research plan is found in the experiences of two members who, after a report of one sub-committee on internal transportation problems, effected a saving of $35,000 a year in each case."

Surely no stronger argument can be ad-

vanced in favor of organized fact-finding and the application of knowledge thus acquired for mutual benefit.

MARTYRS TO THE SCIENCE OF HUMAN WELFARE

THE mining man, the construction engineer, and the general contractor, engaged in all sorts of undertakings that change the face of nature for one purpose or another, are called upon to do their work the world over and to contend with conditions that imperil life and health. They face these hazards courageously and cheerfully, knowing that the completed tasks will be enduring monuments to their labors even though they may sacrifice themselves to insure consummation.

We have been recently reminded, by the deaths of Drs. HIDEYO NOGUCHI and WILLIAM ALEXANDER YOUNG, both at Accra, on the African Gold Coast, of another type of work, also serving the public welfare, involving risks willingly run and lives forfeited that the annual toll of yellow fever may be ultimately reduced both among the native population as well as among others called to labor in the infested districts.

The recent deaths of these men, engaged in medical research, round out momentarily a long list of other martyrs who were similarly occupied in efforts to combat disease and to provide surer defenses for mankind in all parts of the globe. These men rear no tangible monuments to themselves, but they win, instead, the appreciation and the grateful acknowledgments of that vast number who are the ultimate beneficiaries of the hazards run or the sacrifices made. None will be more ready to voice his thanks for this noble work than the mining man, the engineer, or the general contractor who knows full well what it is to carry on in places where many forms of disease still prevail.

A QUESTION ANSWERED

IN the article entitled *Making Fine Progress on Marathon Tunnel in Greece*, appearing on page 2392 in our April issue, the statement is made that "In order to insure perfect ventilation of the tunnel, Chief Engineer R. H. Keays has resorted to the expedient of drilling holes from the top of the tunnel to the surface of the ground at intervals of about 1,000 feet back from the headings."

This means, of course, that the holes in question are drilled from the surface of the ground down to the roof of the tunnel—a well drill being employed to do this work. They are driven in advance of the tunnel at intervals of 3,280 feet; are usually 10 inches in diameter; and have attained a maximum depth of 575 feet. The primary purpose of the holes is that of exploring the ground: afterwards they serve to ventilate the tunnel and to introduce power wires.

It is estimated that the world consumption of nitrogen now exceeds 1,500,000 tons annually and that it is increasing yearly at the rate of approximately 50,000 tons.

SAFARI, A SAGA OF THE AFRICAN BLUE, by Martin Johnson. An illustrated volume of 294 pages, published by J. P. Putnam's Sons, New York City. Price $5.00.

THIS is a story of the African wilderness that teems with thrills and near-thrills every few pages from cover to cover; and to make the text just that much more convincing the author has interspersed his story with numerous (more than three score) striking photographs—many of them taken at the risk of life and limb. Mr Johnson and his wife, with 200 natives, penetrated the wilderness to a distance of 500 miles from the nearest civilized community; and what was seen and what was encountered have been described in a thoroughly arresting manner. The book is an extremely readable one

PROBABILITY AND ITS ENGINEERING USES, by Thornton C. Fry, Ph. D. A volume of 476 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $7.50.

TO quote the author: "It is the fundamental purpose of the theory of probability to answer such questions as: What is the probability of tossing an ace with a die? What is the probability that Christmas falls on Monday? What is the probability that the next child born in New York is a girl? What is the probability that 20 sheets of paper in a package of 500 differ from the average by more than 1 per cent in thickness?"

These examples are in a sense trivial, but they serve to show the diversity of questions about expectation, correlation, and the like that may arise in the manifold activities of business, industrial, engineering, and social life. With certain factors known, it is possible to arrive through mathematics at the likelihood or probability of a given situation or occurrence, and to that extent remove the problem from the realm of sheer speculation or guessing. In engineering this is a matter of outstanding importance because it reduces to a minimum those uncertain factors for which allowance must be made in designing or operating a structure or a piece of machinery.

MATTER, ELECTRICITY, ENERGY, by Professor Walter Gerlach and translated by Francis J. Fuchs, Ph. D. A work of 427 pages, published by D. Van Nostrand Company, Inc., New York City. Price $6.00.

THE purpose of the author has been to produce a scientific treatment of atomistic fundamentals without the aid of technical mathematics and phraseology. In this he has been highly successful. The book should appeal to that great group of scientists whose activities overlap the field of physics. Professor Gerlach has wisely not attempted to deal with the whole field of atomistics; he has, instead, confined his expositions to certain of its developments—the intention being to stimulate further search on the part of the reader.

Westinghouse Catalogue of Electrical Supplies, 1928-1930. A comprehensive volume of 1171 pages, containing descriptive matter and prices of all products made by the Westinghouse Electric & Manufacturing Company. The catalogue is profusely illustrated; and a copy of this publication should be in the possession of all purchasing agents and others who have to do with the use or the sale of such appliances. The volume is issued by the company's advertising department, in East Pittsburgh, Pa

Portable Air Compressors, Type 20, is a brochure recently issued by the Ingersoll-Rand Company, 11 Broadway, New York City. It is the last word by this progressive company on the subject of portable compressors in whose building and developing that concern has been a pioneer. Besides dealing in detail with various features of the portable compressor and with adaptations of that type of mobile power plant, the publication contains descriptive matter having to do with a wide range of air-driven rock drills and pneumatic tools that can be used to advantage in connection with portables. The pamphlet should be in the hands of contractors, engineers, and organizations engaged in structural work of any sort.

C-E Air Preheater is the title of Catalog AH-3 issued by the Combustion Engineering Corporation, 200 Madison Avenue, New York City. The purpose of the publication is to show how it is possible to return to the furnace a large proportion of heat ordinarily lost in flue gases.

Roller Bearings in Railroad Service and *Nickel Alloy Steels for Roller Bearings*, are the titles of two leaflets recently issued by the International Nickel Company, New York City. They contain much valuable information.

The United States Bureau of Mines has recently announced the following new publications, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

BULLETIN 245. Mining of Thin Coal Beds in the Anthracite Region of Pennsylvania, by Dever C. Ashmead. 113 pp., 57 figs., 30 cents.

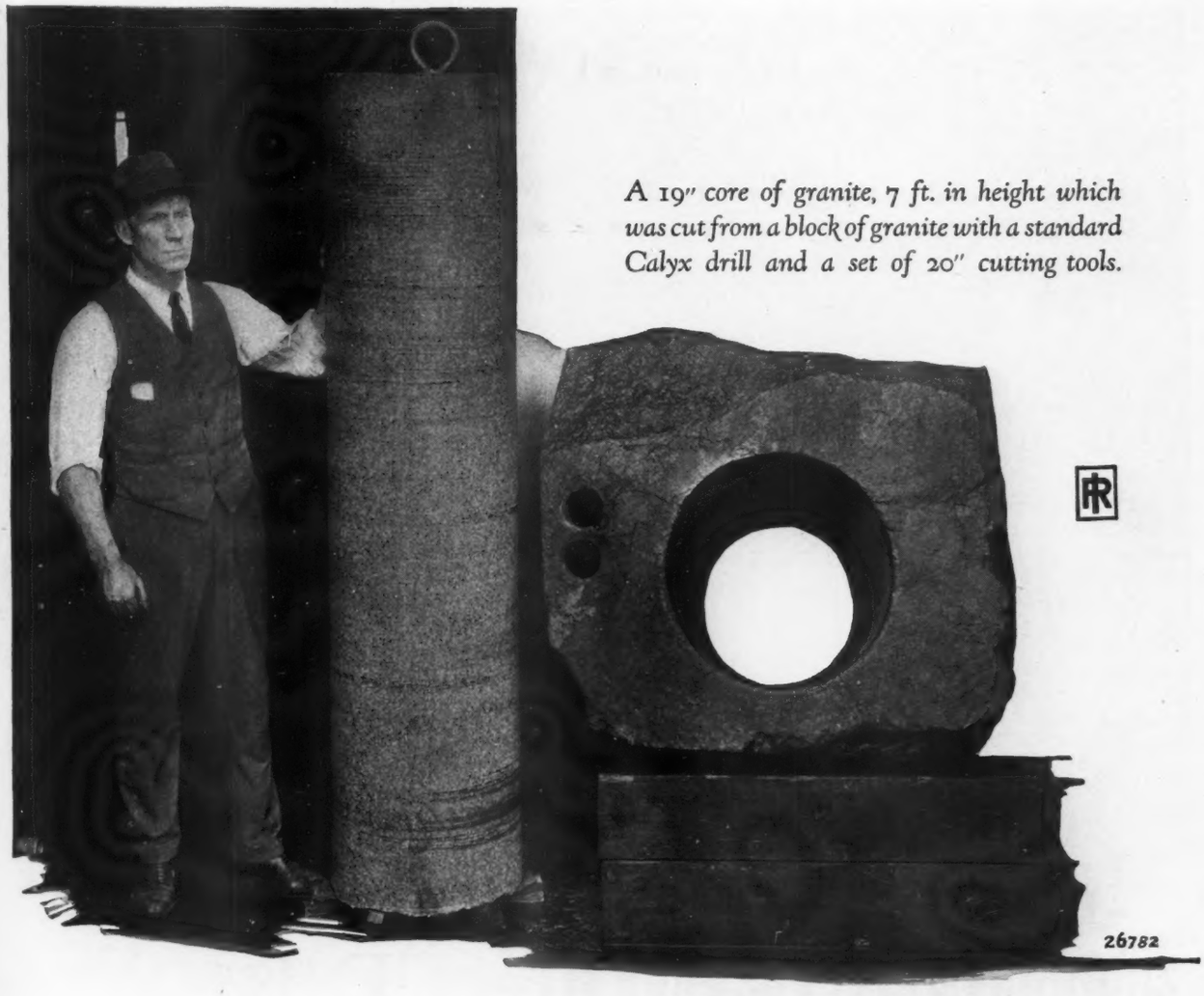
BULLETIN 274. Potash Mining in Germany and France, by George S. Rice and John A. Davis. 92 pp., 23 figs., 25 cents.

BULLETIN 289. Petroleum Refinery Statistics, 1926, by G. R. Hopkins. 92 pp., 4 figs., 20 cents.

TECHNICAL PAPER 403. Hydraulic Classification: Its Theory, Mechanical Development, and Application to Ore Dressing, by A. W. Fahrenwald. 51 pp., 20 figs., 15 cents.

TECHNICAL PAPER 417. Analyses of Indiana Coals. 50 pp., 2 figs., 10 cents.

A piece of steel 2 inches square and weighing a pound is worth $300,000 when made into hairsprings for fine watches.



A 19″ core of granite, 7 ft. in height which was cut from a block of granite with a standard Calyx drill and a set of 20″ cutting tools.

Cores of any Size

Only a "Calyx" drill can take out a core like this. And only a "Calyx" drill can give you a second or duplicate record of the materials passed through.

An exact section of the strata penetrated is held in the core barrel while the cuttings are deposited in reverse order in the "Calyx"—hence, a perfect core and duplicate record.

The "Calyx" drill is used extensively in all parts of the world for general prospecting, soundings for bridge, dam, and building foundations. The standard drills are built in sizes to take out cores from 1″ to 19″ in diameter and to a maximum depth of 4000 feet.

The latest application of the "Calyx" drill is in connection with the *wire saw method* of quarrying slate. Here holes 36″ in diameter are drilled to a depth of 10 to 12 feet for carrying the tension poles, sheave, and wire.

Let us tell you more about these diamondless core drills.

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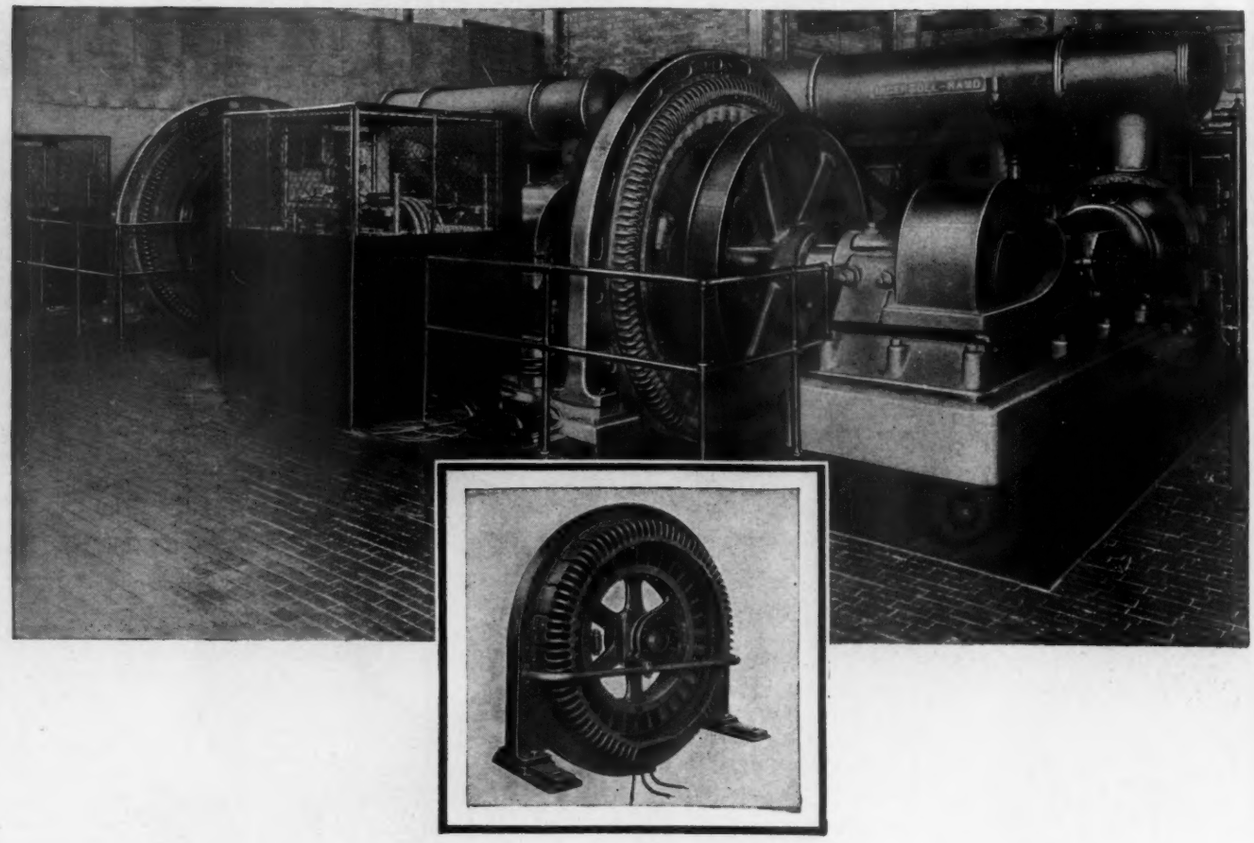

Minimize Compression Costs with G-E Direct Drive

Eliminate belts, and you eliminate their attendant maintenance troubles and power losses.

Couple motor and compressor closely together, and you save floor space.

Use synchronous motors in compressor operation, and you make improvement of power-factor possible *all the time.*

The nearest G-E office will be glad to show you how to effect these economies on your compressor installations.

G-E Motorized Power is individually fitted to each compressor by close coöperation of G-E engineers with the compressor builder. A unit is thereby formed which gives you complete assurance of satisfactory operation.

Motorized Power
–fitted to every need

107-29

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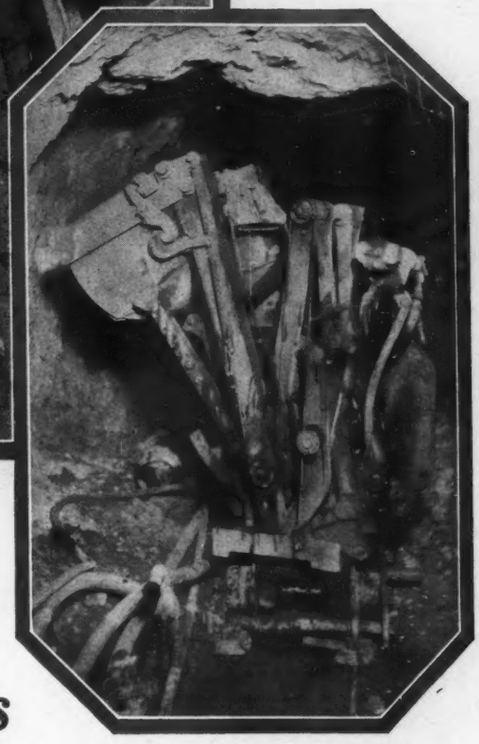
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES



Large Tunnels— Narrow Drifts

Nordberg-Butler Shovel meets a wide variety of underground loading conditions

Here can be seen the wide range of service to which the Nordberg-Butler Shovel can be used. In driving a large hydro electric tunnel, two machines are working abreast at the face, while in the other picture the mine drift is so narrow that the machine barely has revolving clearance.

Although light in weight, it is built for heavy duty; the materials used in its construction are placed exactly where needed. It is compact enough for confined places; it will do the work of larger and more expensive machines on the big jobs too.

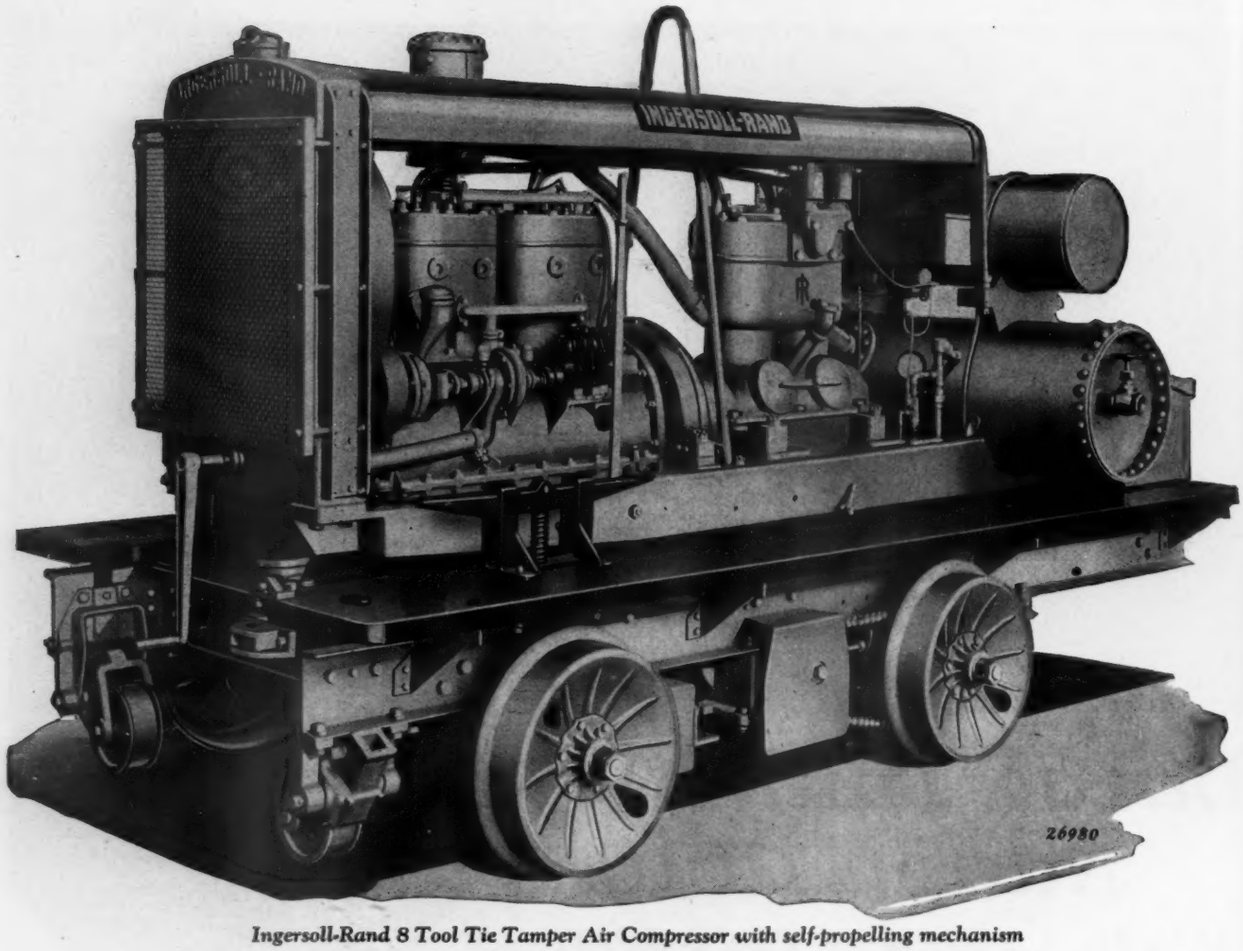
That the Nordberg-Butler Shovel is successful for others is proof that it can be successful for you. Tell us about your underground loading conditions. Let us send you bulletin DR-6.

The Nordberg-Butler Shovel operates on compressed air. It is full revolving and will load into cars at either side, or directly back of the machine. Owing to the compactness of its design it can be used in tunnels and drifts as small as 5½ x 7 ft., but the wide cleanup path of 18 ft. makes it equally suitable for operations of large size. The ¼-yd. dipper working at a maximum of 3½ passes per minute gives this machine an unusually large capacity.

Nordberg Mfg. Co., Milwaukee, Wis.

NORDBERG-BUTLER SHOVEL

A Low Cost Shovel for Mines and Tunnels



Ingersoll-Rand 8 Tool Tie Tamper Air Compressor with self-propelling mechanism

Another Big Improvement In Railway Portable Compressors!

Ingersoll-Rand Self-Propelled Tie Tamper Compressors are now equipped with an air motor for driving the compressor car. The air motor is of the four-cylinder type, and the driving mechanism is a sprocket and chain arrangement direct from the air motor to the axle.

This drive gives a wider range of speed and better control. The air motor also serves as an auxiliary brake on descending grades. There are no gears to engage or strip—no clutch to get out of order.

Other features include: (1) swivel-type transverse wheels, which also serve as lifting jacks and eliminate the need for hydraulic, pneumatic, or other types of lifting jacks; (2) draw-bar connection on both ends of car for towing; (3) three-point mounting of compressor on railway car.

New features—improved design—better materials—all make Ingersoll-Rand Tie Tamper Compressors the most modern and economical machines for railway work. Ask for complete information.

Ingersoll-Rand Company is the pioneer in the development and introduction of labor-aiding compressed air equipment for railroad track construction and maintenance. By reason of its long experience, Ingersoll-Rand can offer a superior service—one which will help produce the best results with such equipment.

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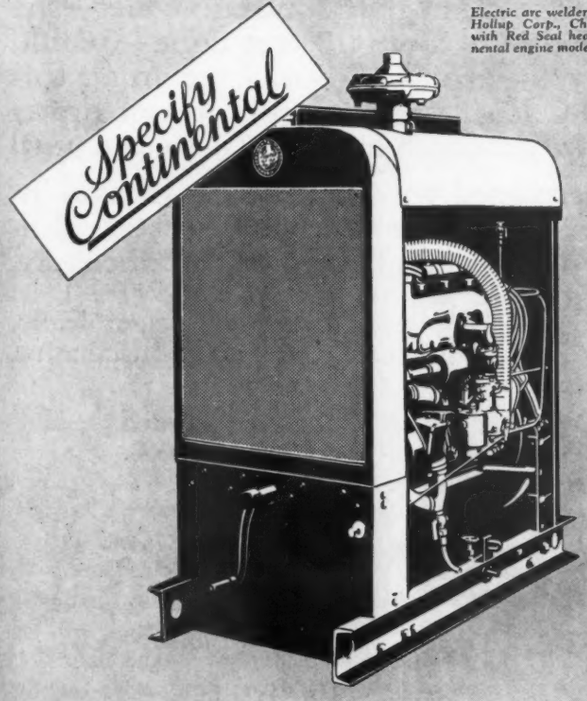
Ingersoll-Rand

Dependable Power for Every Purpose

CONTINENTAL MOTORS — Power that pulls the Nation — AMERICA'S STANDARD

Electric arc welder built by C. H. Hollup Corp., Chicago, powered with Red Seal heavy duty Continental engine model P-20.



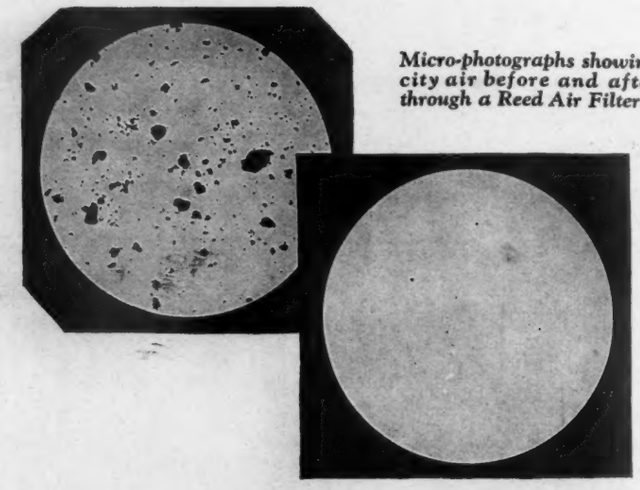
POWER FOR ELECTRIC WELDERS

The great usefulness and practicability of the gasoline engine for arc welding has resulted in manufacturers choosing this power almost 100%.

Continental, with its wide power range serving so many diversified industrial callings is of particular service in the electric welding field. In fact, the majority of arc welders today are powered with Red Seal Continental motors.

CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
Office and Factory: Muskegon, Michigan
The Largest Exclusive Motor Manufacturer in the World

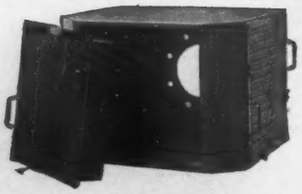
Continental Motors



Micro-photographs showing ordinary city air before and after passing through a Reed Air Filter.

Don't Fool Yourself!

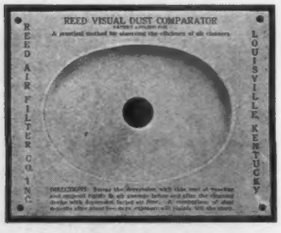
Whatever your location—however clean it seems—unfiltered air can RUIN *your engine and compressor*



A Reed Type S.C.F. Air Filter, 1800-C.F.M. capacity. Reed Filters can increase the life and efficiency of equipment from 25% to 75% and pay for themselves by savings in lubricating oil and maintenance expense.

IMAGINE air so clean that 1000 cubic feet—the air enclosed in a room 10 feet cube—would contain only *two grains* of dust. Even in air this clean, a 750-C.F.M. engine or compressor draws in *one pound of dust each week—52 pounds a year!*

This dirt, permitted to enter the air intake, inevitably causes excessive "carbon", scored cylinders, pollution of oil and rapid loss of efficiency. *Don't fool yourself about your air.* Get the *free* Dust Comparator on the left and determine, scientifically, how certainly Reed Filters can justify their installation on your equipment.



Send for This

A Reed Visual Dust Comparator for running a test on the air supply of engine or compressor. Gladly sent, without obligation, on receipt of coupon below.

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Representatives in Principal Cities

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TRADE *filters* ALL METAL MARK

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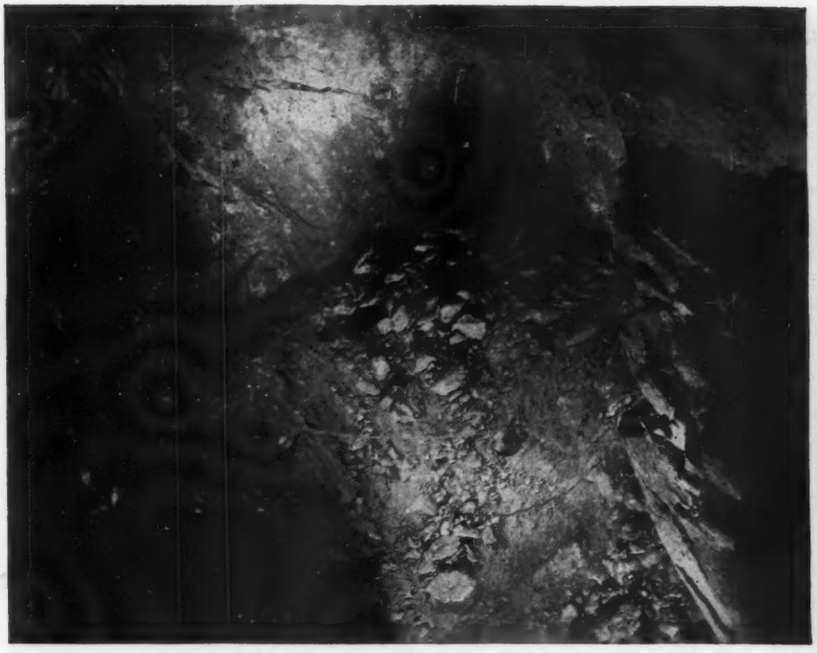
Send, without obligating me, a FREE Reed Visual Dust Comparator together with quotations on the proper Reed Filter for a Engine Compressor, ... Type, ... C. F. M. Displacement.

Name ..... Company .....

City ..... State .....

Cadet Light
Especially desirable for small stopes and roof trimming. Weighs 30 lbs. charged. One full charge burns for 5 hours.



This photograph was taken in a large zinc mine. The stope is about 50 ft. high. Notice how clearly the boulders on the slope can be seen. One Carbic Light (Style No. 2) was used for illumination.

Style No. 2
For illumination in large stopes. Weighs 37 lbs. empty and 115 lbs. charged. One full charge burns for 12 hours.

Prevent accidents in the stopes —*use more light*

THE constant danger that exists in stope mining operations is well known to safety engineers and operators. Roof falls and boulders rolling down the slope are the frequent cause of accidents. With only the individual lamps carried by the miners it is difficult for them to see the condition of the stope. More light will help prevent these accidents.

A *powerful flood light*

The Carbic Flood Light is exceptionally well suited for stope illumination. Tests carried on during the past year in metal mines in various sections of the country have proved the advantages of the Carbic Light for this purpose. A Carbic Light will clearly illuminate the largest stope so that the entire working area stands out in sharp relief.

Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

The Carbic Light is not new

Its dependability has been proven by more than 14 years of use on the surface. Thousands of Carbic Lights are being used by contractors for night work.

The Carbic Light is simple in construction. It can be charged in three minutes. There are only three parts. It is portable. It can be easily carried from stope to stope. It is absolutely safe. If it is knocked over, the water runs out and generation stops immediately. The Underwriters' Laboratories, Inc., list the Carbic Light as standard.

If your jobber cannot supply you, write to our nearest district office.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
New York City, 30 East 42d St. — UCC — Chicago, Peoples Gas Bldg.
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CARBIC LIGHT

"They all like the little ones"

Little? Yes, and *light*—9¼ pounds! Tom is second floor maintenance man at the Mullins Body Corporation, Salem, Ohio, and keeps more than 75 Rotor Air Tools going in his spare time between maintenance calls.

And most of these tools run 20 hours a day!

Ask for our Catalog.

The Rotor Air Tool Company
5905 Carnegie Avenue
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GRINDERS • BUFFERS • SANDERS • DRILLS

Rotor Air Tools

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One of the largest railroad shops made this test of pneumatic drills

A stock Ingersoll-Rand Pneumatic Drill (Size CCSB) was tested against an older type of drill of the same size, not equipped with governor control. This drill was offered in competition to the I-R drill for the same class of work.

Staybolt Tapping Test:

Average time tapping $1^1/_{16}$" staybolt holes:

Ingersoll-Rand Drill . . 28½ seconds
Older type drill . . . . 35¼ "

Prony Brake Test:

Maximum Horsepower developed on brake:

Ingersoll-Rand Drill 2.00
Older type drill 1.82

Time Required to Completely Dismantle and Reassemble Drill in case of repairs:

Ingersoll-Rand Drill . . 29 minutes
Older type drill . . . . 1 hr. 47 min.

Air Consumption per Brake Horsepower:

Ingersoll-Rand Drill . . . 23.5 cu. ft.
Older type drill . . . . . 34.1 " "

The I-R Drill tested →

I-R Long-Stroke Pneumatic Drill

Equipped with Automatic Speed Governor

—*and then—how about maintenance costs?*

In answer to this, another railroad shop reports that for ten Ingersoll-Rand Drills in use over a period of two years, only $1.20 was spent for repair parts.

The high power, low air consumption, reliable operation, and low maintenance cost of these drills make them the greatest value in air drills yet available. Furthermore, on tapping work, the governor control gives a more uniform speed, saving wear and tear on the taps and producing better threads in the sheet.

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418-PT

Ingersoll-Rand

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P&H

Bulletin 62-X fully describes the 5 models in which P & H Gasoline Motored machines are made and the Diesel models of 1 and 1¼ cu. yd. capacities.

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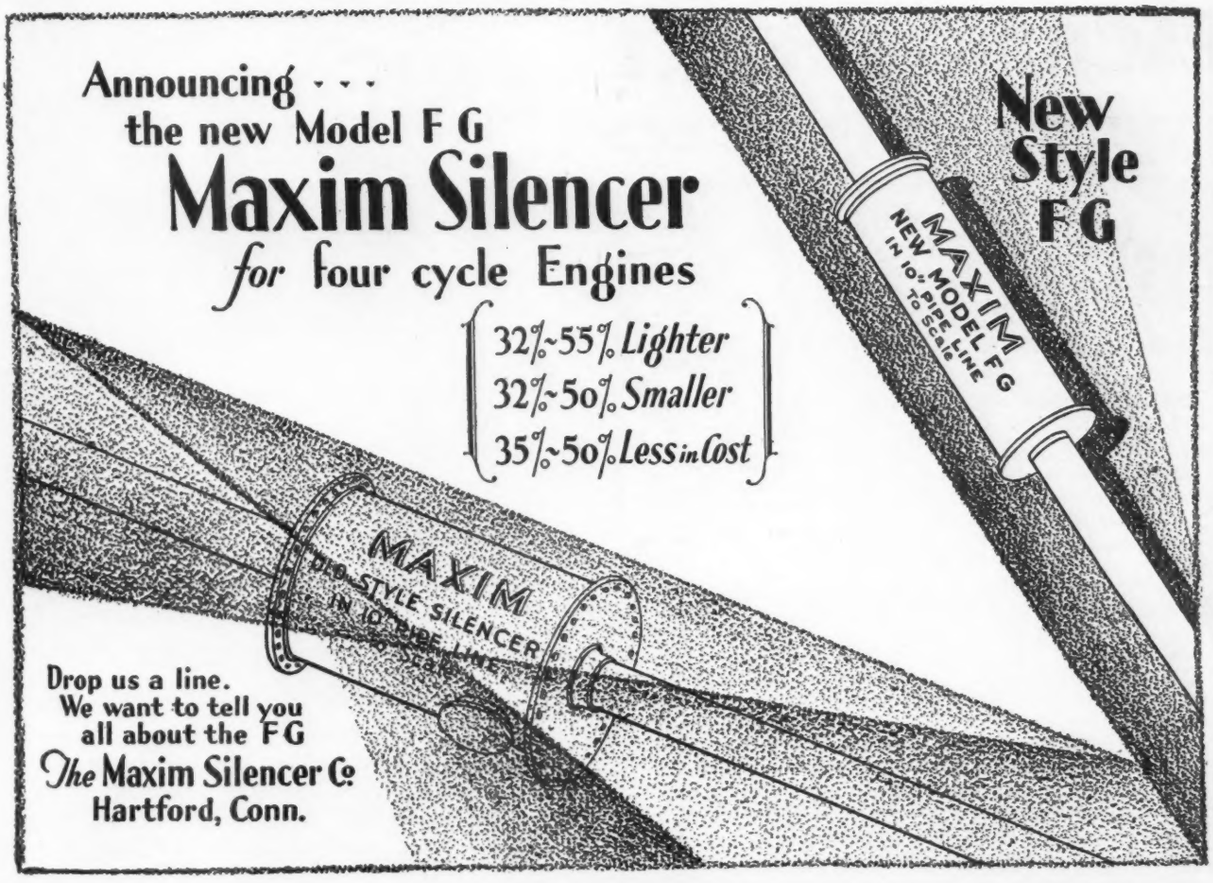

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We want to tell you
all about the F G
The Maxim Silencer Co
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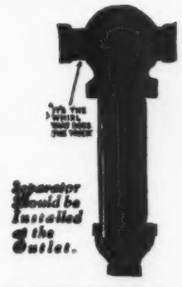

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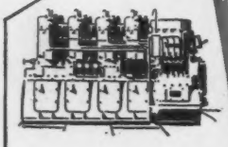

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Metal or Fibrous Packings for Piston Rods, Fuel Valves, Water Pumps. Oil Wiper Packing and Gaskets.

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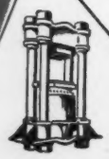
Packing for Pistons Rods and Valve Stems on Main Engines, Auxiliaries and Pumps. Gaskets for all Purposes



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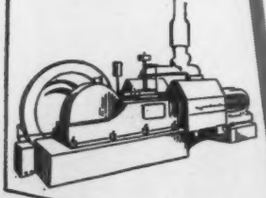

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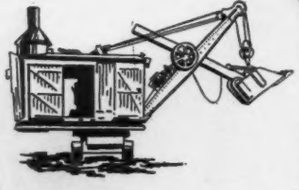
Piston and Valve Rod Packings. Water Pump Packings. Compressed Asbestos and Rubber Gaskets



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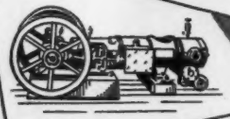
Metal or Fibrous Packings for Piston Rods. Oil Wiper Packing and Gaskets



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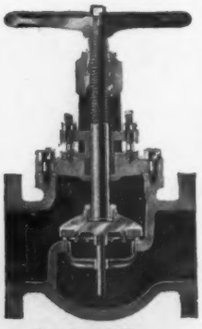

Sectional View.
Fig. 162, flanged, Jenkins Extra Heavy Iron Body Globe Valve

Rigid standards of manufacture are rigidly maintained to safeguard the user of Jenkins Iron Body Valves—to assure him of the same degree of trouble-free service as he has learned to expect of the bronze line.

Care is exercised in the selection of metal. The iron is analyses-proved by competent metallurgists, both before casting and after.

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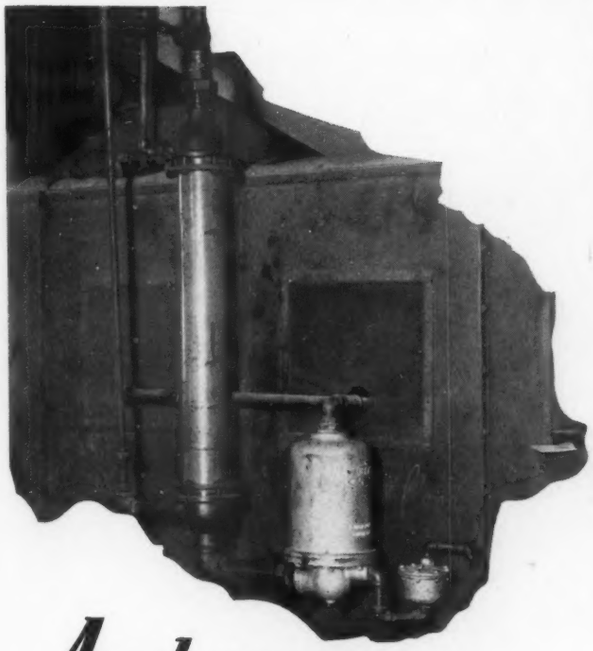

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THE necessity of conditioning compressed air for most satisfactory operation of pneumatic equipment has long been acknowledged. Gast Air Separators have successfully been removing free moisture in thousands of compressed air installations. The newly developed Gast Aftercooler gives added protection by condensing the invisible moisture from compressed air before it reaches the pneumatic tools and machines.

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"You can do it better with Gast"

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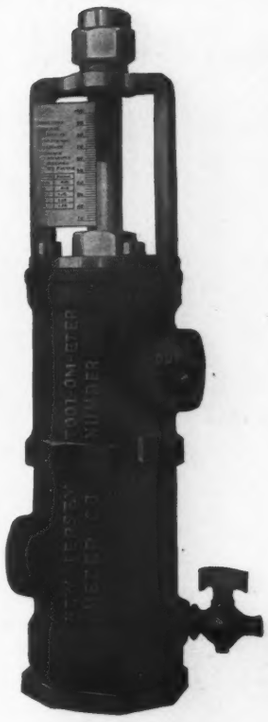

THE TOOL-OM-ETER

shows instantly the flow of air in a pipe or hose, measures the actual consumption of any tool, machine or process operated by Compressed Air, enables you to maintain equipment in economical condition throughout its useful life.

Adopted by leading pneumatic manufacturers and by Compressed Air users in all parts of the world.

Write for Bulletin A-6.

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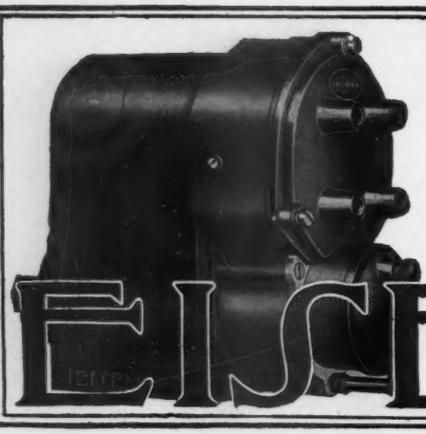

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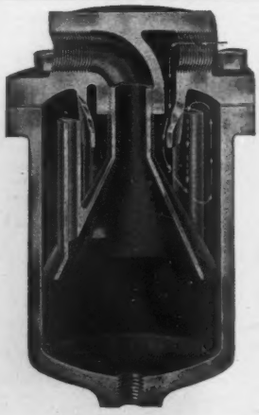

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for removing oil and water from compressed air. 30 years experience in designing separators.
Cyclone Suction Sand Blast Nozzles for Cleaning Iron, Steel, Brass and Stone.

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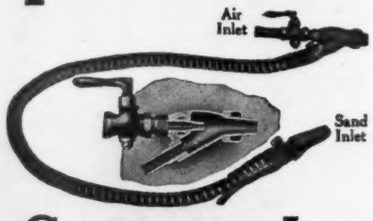
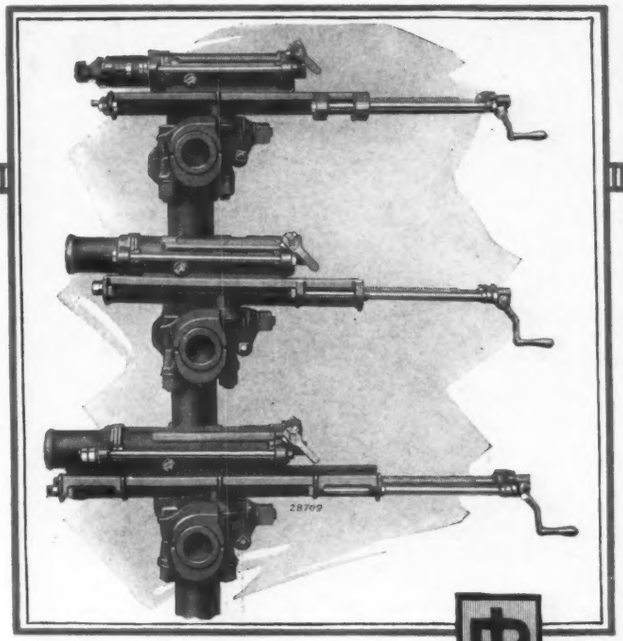


The Direct Separator Company, Inc.

Syracuse, N. Y.

Details of Ingersoll Rand's new High-Speed Drifters-

L-74
N-75
S-70



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4—Low center of gravity—minimum vibration.
5—Higher drilling speed and overall efficiency.
6—New I-R Valve; simple, dependable and efficient.

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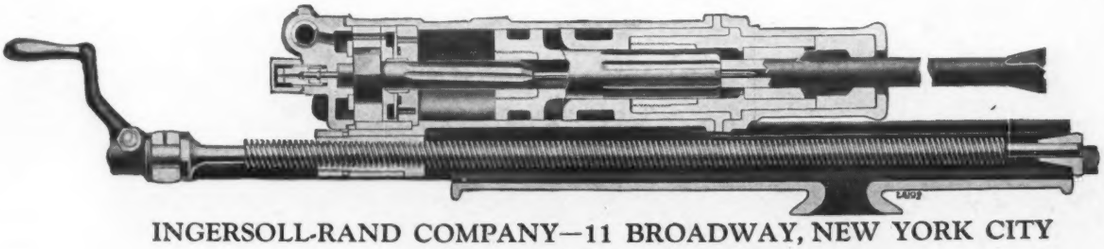
Weight . . . 110 lbs.	Weight . . . 138 lbs.	Weight . . . 185 lbs.
Bore . . . . . 3″	Bore . . . . . 3½″	Bore . . . . . 4″
Height Overall . 8⅜″	Height Overall . 8-9/16″	Height Overall . 9-3/16″



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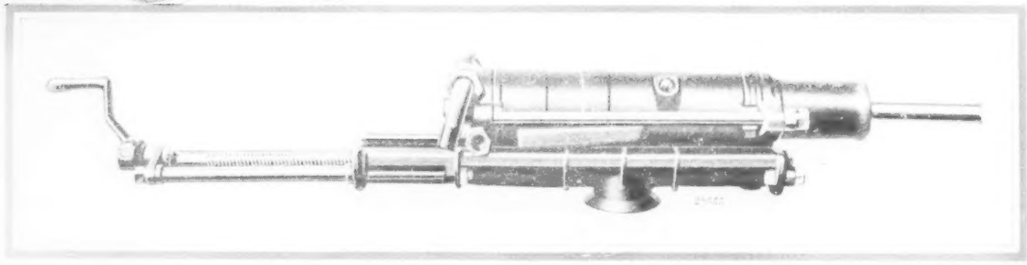

See Previous Page
for details of these new drills

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